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ABSTRACT

The 10-volume "Health Facts" series is intended to supplement health education curricula and provide a handy reference for individuals who would like additional background information on particular health topics. The emphasis is placed on topics and examples relevant to youth of middle and high school age. This book is divided into two parts: Part 1 on environmental health and Part 2 on community health. Part 1 has three parts with information on: environmental issues and community concerns; different kinds of environmental pollution; natural environmental cycles including air, soil, and water; and the role of government, industry, agriculture, and the indiviual in protecting the environment. Part 2 contains two sections on: threats and approaches to community health; and community health resources and services at the national, state, and local levels. An easy to read reference format offers clear, concise data intended to familiarize educators with the most important facts about the issues and concerns. A glossary, a resource list, and 27 references complete the volume. (LL)

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Environmental and Community Health

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Environmental and Community Health

HEALTH FACTS

Nora J. Krantzler, PhD, MPH

and

Kathleen R. Miner, PhD, MPH, CHES

ETR ASSOCIATES
Santa Cruz, California
1994

ETR Associates (Education, Training and Research) is a nonprofit organization committed to fostering the health, well-being and cultural diversity of individuals, families, schools and communities. The publishing program of ETR Associates provides books and materials that empower young people and adults with the skills to make positive health choices. We invite health professionals to learn more about our high-quality publishing, training and research programs by contacting us at P.O. Box 1830, Santa Cruz, CA 95061-1830, 1-800-321-4407.

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Editor's Preface

Everyone agrees that children and youth need to learn skills for establishing good health habits. Most people also agree that the earlier health education starts, the better its success.

The books in the *Health Facts* series were written to provide the background information educators need as they teach young people about health. The information is provided in a way that makes it easy for educators to familiarize themselves quickly with the most important facts about a health topic.

Rather than providing indepth information in each content area, the books offer guidance to the balance of emphasis. They help educators approach health topics with confidence and focus health content as they teach.

Titles in the Series

Each volume in the series contains information about a different content area. The following ten books comprise the series:

- *Disease Prevention*
- *Drug Use Prevention*
- *Environmental and Community Health*
- *Fitness*
- *HIV Prevention*
- *Injury and Violence Prevention*
- *Mental and Emotional Health*
- *Nutrition*
- *Sexuality*
- *STD Prevention*

Contributors

These books were written by the following talented and knowledgeable professionals in collaboration with ETR Associates' staff.

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Kathleen R. Miner, PhD, MPH, CHES, is associate professor and coordinator of health promotion and education in the Division of Behavioral Science and Health Education at Emory University School of Public Health. She has traveled internationally as a health educator and is the author of many articles about education and health. A former high school health and biology teacher, she has been a key contributor in designing these books to be useful to teachers.

Lucas Stang has a background in biology and health, with graduate work in science communication. He has been writing health materials for ten years. He recently served as wellness coordinator for the International School in Manila, Philippines, where he developed a kindergarten through grade 12 health curriculum and taught high school health. He has also taught human sexuality at the junior college level.

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John T. Boothby, PhD, is an associate professor at San Jose State University in San Jose, California, where he teaches microbiology and immunology.

Rama Khalsa, PhD, is a clinical psychologist and the director of the Santa Cruz County Department of Mental Health in Santa Cruz, California.

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In addition, we would like to thank Mary Nelson, publisher of ETR Associates, for the concept idea, Kathleen Middleton, editor-in-chief of ETR Associates, for her review and conceptualization, and Jill Schettler for her help in editing.

Netha Thacker
Project Editor

Introduction

We do not inherit our world from our forefathers.
We borrow it from our children.

American Indian Proverb

The planet Earth is the only one in the solar system that has the right combination of substances and conditions to support life. All living things on Earth rely on the resources of this planet for their survival.

The earth is a closed system. If nonrenewable resources are depleted, there is no alternative but to learn to live without them. If an animal or plant becomes extinct, there is no chance for repopulation. Once the oil and coal reserves are gone, there are no practical alternates to take their place.

Once the world's trees are cut or burned to the ground, it will take several human generations to reforest the redwoods of the Pacific Northwest, the teak forests of Southeast Asia and the mahogany trees of the South American rain forests. Once all the trees are gone, they are gone forever.

While political and economic realities dictate that the people who occupy a country control the natural resources of its land, the air, water, minerals and soil do not follow the rules of citizenship. None of the earth's natural elements know a nationality. If a country emits pollutants into the air, the atmospheric winds will blow the contaminants into the skies of other nations. If a country allows untreated sewage to be released into its coastal waters, the ocean tides will distribute the waste to beaches throughout the world.

Just as with natural resources, diseases do not know national boundaries. Communicable diseases are transmitted through air, water, animal vectors and from person to person. Outbreaks on one continent can spread around the world through imported products, tourism, shared water and air, and contaminated foods. All diseases should be treated as though a disease somewhere in the world could occur anywhere in the world.

What kind of world will the next generation of children enter? Will it be one that is rife with disease and depleted of its natural resources? Or will it be one that is disease-free and rich with reserves of fossil fuels, bountiful forests, fresh air and clean water? Answers to these questions will be found in the willingness of current generations to temper their consumption of resources and to be generous in their efforts to restore, conserve and protect the assets of the living planet called Earth.

Environmental and Community Health: Health Facts is in two parts. Part One presents an overview of environmental health issues and concerns. It discusses important conservation issues, such as toxic waste control and chemical contamination of the air, water and soil. Part Two discusses the basics of community health principles, including epidemiology, public health planning and disease prevention.

The Role of Education

The research conducted during the past thirty years has offered greater insight into the causes of chronic disease, injury and violence. This research indicates that these conditions are primarily caused by human behavior. What people do or do not do places them at risk of acquiring chronic diseases or experiencing serious injuries.

The behavioral components associated with the modern pattern of disease and injury create the potential for preventing most of these health problems by changing behavior. Comprehensive health promotion and education programs provide the foundation for modern disease prevention.

Ideally, the health promotion and education process begins early. Early education provides the opportunity to reach children and youth before they begin to adopt the behaviors associated with chronic disease, sexually transmitted disease, drug use, injury and mental illness. Through a systematic review of health promotion and disease prevention, educators can help children and youth enhance their health while helping them avoid illness and injury.

The *Health Facts* Series

Environmental and Community Health: Health Facts is part of a ten-volume series designed to provide clear, concise content and to be complementary to curricula published by ETR Associates and other health education curricula. Another volume in this series that relates to environmental and community health is *Disease Prevention.*

Classroom teachers, counselors, school nurses and others are often called upon to become instant health educators. They may be asked to answer questions, present information and lead discussions on health topics in which they feel unprepared.

The *Health Facts* series is designed to be a handy reference for individuals who would like additional background information on particular health topics. The emphasis is on topics and examples that are relevant to youth of middle and high school age. By design, the presentation of each of the topics is brief. References and resource listings direct the reader to additional relevant information. All of the volumes in this series offer a user-friendly format that is easy to read and factual.

The volumes discuss health and disease in straightforward language. Educators may want to review each volume for its appropriateness for their school and community before assigning the books for student use.

This book and the rest of the series can serve as useful additions to classroom, school or library collections. Health care professionals may choose individual volumes or the entire series as a convenient reference for patient education programs or as reading material in office waiting rooms. Individuals may find the series useful as a home reference as well.

PART I: ENVIRONMENTAL HEALTH

THE ENVIRONMENT: AREAS OF CONCERN

MYTH: Industry and agriculture are responsible for most environmental pollution.

Fact: Although some industrial and agricultural practices do contribute a significant amount of pollution, the cumulative effects of individuals also have an impact. Ultimately, people are responsible for environmental pollution.

The environment is a critical factor in the health of individuals and communities. Everything in the environment plays a role in people's sense of well-being.

Maintaining a clean and safe environment affects physical, mental and social functioning. A clean environment decreases the spread of disease-causing germs and lessens the chance of physical harm from potentially dangerous chemicals.

Many people think that a pleasant environment can help stimulate the mind and reduce stress. Social interactions are enhanced in environments where noise levels are tolerable.

Environmental pollution is one of the most serious problems facing the world today. Air, water and soil, which are essential to human survival, are all harmed by pollution.

What Is Environmental Pollution?

Environmental pollution is a term that refers to all the ways that people pollute, or contaminate, their surroundings. Waste products causing pollution are called *pollutants*. While some types of pollution arise from natural processes (such as volcanic eruptions), most pollutants are the result of human activities, such as manufacturing and driving motor vehicles.

People pollute the air with gases and smoke, contaminate the water with chemicals and other substances and damage the soil with excessive use of pesticides and fertilizers. They operate machinery and motor vehicles that produce noise. Almost everyone causes environmental pollution in some way.

When air is badly polluted, it can cause illness and even death. Polluted water can kill aquatic life and cause harm to human populations. Polluted soil reduces the amount of land available for growing food and can contribute to famine and starvation.

The Issues Are Complex

Reducing environmental pollution is a complex matter. Part of the problem is that much pollution is caused by things that benefit people. For example: Exhaust from motor vehicles causes a large proportion of all air pollution, but motor vehicles provide needed transportation for millions of people. Much of the air and water pollution is caused by manufacturing, but manufacturing also provides jobs for people and produces goods that people want. While fertilizers and pesticides can ruin soil, they are also important aids to growing crops.

Brief Historical Background

Since prehistoric times, people have always caused some environmental pollution; however, pollution was light and spread out over large areas.

Problems with pollution first arose when people began to live in cities. In the 1700s and early 1800s, the Industrial Revolution in Europe and the United States brought about the

development of factories and cities overcrowded with factory workers. Coal, used as the major source of energy and heat, polluted the air with smoke and soot. Poor sanitation practices in cities caused water sources to become polluted with raw sewage, which helped to spread diseases such as typhoid fever.

In the United States, air pollution problems in industrial cities began to become serious by the 1930s. Since the 1950s, many industries have used cleaner fuels; for example, coal burning has been replaced by the use of oil and natural gas. Cities now treat their water supplies to keep them as germ-free as possible.

Nonetheless, environmental pollution has become more serious and widespread worldwide. The increase in pollution is due to technological changes as well as to population growth. In recent years, some dramatic environmental tragedies have occurred that serve to highlight the seriousness of the problem. They include the 1986 explosion and fire at a nuclear power plant at Chernobyl in the former Soviet Union; the oil spill in 1989 near Valdez, Alaska; and the 1991 Persian Gulf War, where oil wells were deliberately set on fire, polluting the air over Kuwait. All of these events have serious implications for human health.

The Personal Health Connection

Clean air to breathe, pure water to drink and safe land to grow food crops are all basic necessities of life. But air, water and land are also the three major components of the environment that are being threatened. Pollution of the earth's natural resources poses risks to the health of all living things.

The connection to personal health can be taken a step further. Each person's "personal" health is intimately connected with the health of other human beings and the health of the planet.

For example: Each year, 98% of the atoms in a person's body are replaced by other atoms from the environment. Some organs, such as bone, liver and the lining of the gastrointesti-

nal tract, are replaced every few weeks. By the end of five years, 100% of the atoms are replaced. Furthermore, each breath of air inhaled contains millions of atoms that have been breathed by others, and these atoms enter the blood and tissue making up the human body.

When viewed this way, the health of the earth is as important as the health of the individuals and populations who depend upon the earth for survival. Humans can exist without air for only minutes, without water for only days and without food for only weeks. Even the medications people rely on, whether natural or synthetic, have their origins in the earth.

According to this "green" approach, the earth is more than an external resource to be taken care of; it is the stuff of which people are actually made. Thus, efforts to restore the health of the earth are also actions toward personal health.

The Earth as Ecosystem

While concerns about each part of the environment can be considered separately, in reality, they work together as part of a single system. The *ecosystem* is the complex web linking animals, plants, air, water and every other life form on earth.

Any change in one part of the ecosystem affects other parts as well. When the environment in one part of the world is threatened, the rest of the world is also threatened. The study of the relationships among living things, and between living things and their environment, is called *ecology*.

Because of these close relationships, a type of pollution that harms mostly one part of the environment may also affect others. For example: Air pollution damages the air. But when rain washes pollutants out of the air, it deposits them on land and in bodies of water.

The major environmental concerns are focused in five key areas:

- air pollution
- water pollution
- land pollution
- radiation
- noise pollution

Air Pollution

Air pollution is a major problem in modern society. Even though air pollution is usually a greater problem in metropolitan areas, pollutants contaminate air everywhere. These substances include various gases and tiny particles, or *particulates*, that can harm human health and damage the environment.

Some air pollution is caused by natural processes, such as forest fires and volcanic eruptions. However, the pollution caused by human activities, especially the burning of fossil fuels such as coal, oil and natural gas, is of greatest concern.

Urban, traffic-congested areas and areas that are heavily industrial have more air pollution than other places. For example: Someone in a relatively clean suburb or small town might inhale about 40,000 particles of pollutants with each breath, while a city dweller might inhale 70,000 particles of pollutants with each breath.

Air pollution is known to have a harmful effect on human health. Both gases and particulates burn people's eyes and irritate their lungs. Over time, breathing polluted air can result in the development of respiratory diseases, such as asthma, bronchitis, emphysema, pneumonia and lung cancer; heart disease; other cancers; skin diseases; and allergies. For people who already have such health problems, breathing polluted air is even more hazardous and can worsen their condition.

MOTOR VEHICLE EMISSIONS

In the United States, transportation sources are responsible for 69% of the lead and 70% of the carbon monoxide released into the air. These and other gases released by motor vehicles contribute to the incidence of lung cancer, emphysema and other respiratory disorders. By some estimates, these emissions hasten up to 100,000 deaths each year.

Types of Air Pollution

Significant air pollution and related problems include:

- gaseous pollutants
- greenhouse effect
- acid rain
- damage to the ozone layer
- particulate pollutants
- climatic effects

■ **Gaseous pollutants:** The most common gaseous pollutants are carbon dioxide, carbon monoxide, hydrocarbons, nitrogen oxides, sulfur oxides and ozone. A number of sources produce these chemical compounds. The major source is the burning of fossil fuels in motor vehicles, power plants and factories. Cigarette smoking, furnaces, gas ranges, and the use of certain construction materials, cleaning products and home furnishings produce chemical pollutants indoors.

A commonly recognized type of air pollution is *smog*. The term *smog* was coined in 1905 by combining parts of the words *smoke* and *fog*. It was used to describe the air that at times hung over London and other cities in Great Britain.

Today, smog generally refers to a condition caused by the action of sunlight on exhaust gases from motor vehicles and factories. This type of smog is also called *photochemical smog*.

Heavy concentrations of smog are poisonous. In 1952, several thousand Londoners died within five days as a result of a thick smog. Around that time in the United States, twenty people died and six thousand became ill from a photochemical smog over a city in Pennsylvania. Smog can also destroy plant life and cause building materials to deteriorate at a faster rate.

■ **Greenhouse effect:** Some gases, including carbon dioxide, allow sunlight to reach the ground but prevent the sun's heat from rising out of the atmosphere and flowing back into space. The warming of the earth's surface that results is called the *greenhouse effect.*

While a certain amount of greenhouse gases in the atmosphere is necessary to make the earth warm, activities such as the burning of fossil fuels are creating a gaseous layer that is too dense. Many scientists believe that this effect increases the atmospheric temperature and results in *global warming.*

Since the beginning of the Industrial Revolution in the mid-1700s, the level of carbon dioxide in the atmosphere has increased by 30%. Motor vehicle use has been a major contributor of carbon dioxide, as has reduction of tropical forests in Africa and South America. Tropical forests absorb large quantities of carbon dioxide.

Carbon dioxide is responsible for about 50% of the greenhouse effect. Other gases contributing to the problem include:

- **Chlorofluorocarbons,** or **CFCs,** are industrial chemicals widely used in air conditioners, refrigerators, solvents, plastic packaging and foam insulation.
- **Methane** is produced by cattle and rice fields and emitted by landfills when organic waste breaks down.
- **Nitrous oxides** are formed by the burning of fossil fuels, natural microbial activity in the soil and the breakdown of chemical fertilizers.

HOUSEHOLD ENERGY USE

Producing a year's worth of electricity for an average household causes the release of 4.5 tons of carbon dioxide into the atmosphere. Heating one home with oil for one year emits 6.5 tons of carbon dioxide into the environment.

- **Ozone** is a vital component of the upper atmosphere, but at ground level a dangerous pollutant. Motor vehicles, power plants and oil refineries generate ground-level ozone.

With an increase in the atmospheric temperature of only a few degrees Fahrenheit, many scientists predict significant increases in violent storms, unbearable summer heat and prolonged droughts.

Another health concern of global warming is the potential for the proliferation of insects that destroy crops or carry disease. Insects that could not survive colder temperatures would be able to thrive in a warmer climate.

■ **Acid rain:** This pollutant forms when moisture in the air combines with nitrogen oxide and sulfur dioxide released by factories, power plants and motor vehicles that burn coal or oil. As the particles travel through the air, they combine with water vapor to form sulfuric and nitric acids. Eventually, these chemicals fall to the earth as precipitation, or acid rain.

In the United States, the leading producers of sulfur dioxide are the states of Ohio, Pennsylvania, Indiana, Illinois and New York. However, acid-rain pollutants may travel long distances, with winds carrying them thousands of miles before they fall as dew, drizzle, fog, snow or rain.

When acid rain accumulates in lakes and rivers, the water becomes more acidic, damaging or killing aquatic life. The acids can also damage crops and forests and cause harmful changes in the soil. Acid rain can contaminate drinking water, creating a significant hazard to human health. Acid rain is thought to be a major cause of lung disease in the United States.

Acid rain also causes a breakdown of metals in water pipes, producing high concentrations of lead in drinking water. Lead poisoning can cause brain and neurological disorders in children.

- **Damage to the ozone layer:** Air pollution caused primarily by the use of *chlorofluorocarbons* (CFCs) is depleting the earth's ozone layer. Ozone is a form of oxygen consisting of three atoms of oxygen instead of the normal two; it occurs naturally in the earth's upper atmosphere. The thin layer of ozone molecules in the atmosphere absorb some of the sun's ultraviolet (UV) radiation before it reaches the earth's surface, making life on earth possible.

  CFCs have been used as coolants in air conditioners and refrigerators, as solvents in the manufacturing of electronic equipment and as foaming agents in insulation and food packaging. Until recently, CFCs were used as propellants in aerosol spray cans. CFCs destroy ozone.

  The depletion of ozone is causing increased levels of UV radiation on earth, endangering both plants and animals. The risks to humans include higher rates of skin cancer and cataracts, which can cause blindness. Increased exposure to UV radiation may also cause damaging genetic effects and diminished immune system capabilities.

  Concern about the dangerous effects of CFCs has led to efforts to sharply reduce their use by the end of the twentieth century. In 1978, freon gas, a CFC, was banned from use as a propellant in the United States, although it is still used in other countries. The Environmental Protection Agency (EPA) projects that damage already done to the ozone layer will cause more than 80 million new cases of skin cancer during the next eighty years.

Protecting the Ozone Layer

Individuals can help protect the ozone layer in the following ways:

- Avoid the use of plastic foam packaging and insulation materials.
- Use an energy-efficient refrigerator.
- Have car and home air conditioners serviced frequently.
- Use pump rather than aerosol sprayers.

- **Particulate pollutants:** Particulates are tiny particles of substances suspended in the air. Like gaseous pollutants, some particulate pollutants result from natural processes, such as volcanic eruptions, but most are the result of human activities such as manufacturing, agriculture and mining.

  Inhaling particulates can cause potentially fatal respiratory diseases; for example, *silicosis* from quartz dust and *asbestosis* and lung cancer from asbestos fibers. Other particulates of concern are soot, ashes, coal dust and fragments of metals such as lead. These particulates can pollute the air both indoors and outdoors.

  Asbestos has been a major concern because its use was so widespread. The EPA ordered the use of asbestos stopped by the year 1997. By that date, about 94% of all asbestos use will be eliminated. An estimated 27 million workers have been exposed to asbestos. Many of them will develop asbestosis and lung cancer, and billions of dollars in damages have been assessed.

  Another serious health problem associated with particulate pollution is *chronic lead poisoning*. People who live or work in areas with higher-than-acceptable levels of lead in the air may develop damage to blood hemoglobin, the gastrointestinal tract or the central nervous system. Low-income minority children are most likely to be affected by lead poisoning. About 3 million children have dangerously high levels of lead in their blood.

- **Climatic effects:** Two conditions can make air pollution worse: insufficient wind, which limits the dispersal of pollutants, and highly stable air, which does not allow pollutants to escape. A lack of wind often comes with high barometric pressure and is more likely to occur where there are land masses that block the movement of air. When the air surrounding a source of polluted air is warmer than the polluted air trying to move upward, it is called *high air stability*.

When the air is highly stable, a *thermal inversion* can occur. A layer of cooler, polluted air becomes trapped below a large layer of warm, still air. Pollutants cannot disperse, and the environment becomes dangerous for people with respiratory sensitivities or illnesses.

Controlling Air Pollution

Steps can be taken to help control air pollution. Many efforts by federal, state and local governments have been directed at controlling this problem.

Reductions in motor vehicle traffic and in energy use in homes and businesses can reduce concentrations of gaseous pollutants, and can also help reduce the greenhouse effect. Preservation of tropical rain forests is also important.

Industries can take steps to reduce emissions that contribute to acid rain, just as they have taken steps to reduce the use of CFCs to protect the ozone layer.

A study reported in 1993 found that the reductions in the use of CFCs by industries are already having a measurable effect, and worldwide emissions of the two most dangerous forms of the chemical are slowing sooner than expected. As a result, scientists predict that the worst of the ozone destruction should come around the year 2000, followed by a period of recovery taking from fifty to one hundred years.

Industries can use smokestack scrubbing and emission control devices to lessen the release of particulates into the air. People who work in mining, industrial and some textile occupations should wear protective gear, such as face masks, to safeguard themselves from inhaling particulates at the work site. Pollution from industrial particulates has been reduced by the Clean Air Acts and other government controls, but particulates remain a major source of air pollution.

Water Pollution

Like clean air, clean water is essential for sustaining life. Water pollution is one of the most serious environmental problems. It occurs when water is contaminated by substances such as human and other animal wastes, toxic chemicals, metals and oils. Pollution can affect rain, rivers, lakes, oceans and groundwater.

Water pollution can be caused by both natural processes and human activity. Both surface water and groundwater can be polluted with minerals leached from the soil, acids from decaying vegetation and decaying animal products. Pollutants can come from agricultural, urban and industrial sources, as well as from untreated human wastes.

Polluted water may look clean, but it contains germs, chemicals or other materials that can be harmful and cause illness or even death. Water contaminated with sewage can cause diseases such as cholera and dysentery. When toxic substances enter sources of groundwater, streams, lakes and oceans, they can enter the food chain and affect both aquatic and human life.

In developing countries, one of the most important health concerns is the availability of clean and safe water. In countries such as Canada, China, India, Japan and the United States, water pollution has become a serious problem, and governments have passed laws limiting the amount and kind of waste that can be dumped into water. Billions of dollars have been spent on research and water treatment plants to reduce pollution, but the problems persist.

In the United States, several large cities release large amounts of untreated sewage into their harbors or coastal waters. Water that runs off construction sites and farmland can be a source of pollution and is largely uncontrolled. These runoffs can carry pollutants into streams and lakes.

Sources of Water Pollution

There are three main sources of water pollution:

- industrial wastes
- sewage
- agricultural chemicals and wastes

■ **Industrial wastes:** Industrial wastes are the primary cause of water pollution in the United States. U.S. industries discharge three to four times as many pollutants into wastewater as do all of the country's sewage systems combined. These wastewaters contain many toxic chemicals. Much of this waste is released directly into water systems.

Acid rain is another result of industrial processes that involve the burning of coal, oil and other fuels. Acid rain enters streams and lakes when it falls to earth.

Industries also pollute water by using water to cool equipment. When used for this purpose, the water absorbs heat. Discharging the heated water into a river or lake can cause *thermal pollution* that harms plant and animal life.

■ **Sewage:** Sewage includes human wastes, garbage and water that has been used for washing or bathing. In the United States, most sewage goes through treatment plants, which remove solids and dissolved substances such as nitrogen and phosphorus. About 10% of sewage is put through septic tanks and filtered through leaching fields into the land. About 10% of sewage in the United States goes untreated, flowing directly into waterways or the ocean.

Water polluted with human and animal wastes can spread diseases such as typhoid fever, cholera and dysentery. In the United States, about 75% of community water supplies are treated with chlorine to kill disease-causing germs, or *pathogens*. However, disinfection does not remove chemicals or metals that may be harmful to health, such as polychlorinated biphenyls (PCBs), arsenic, lead and mercury.

Groundwater supplies are seriously threatened by the careless release of these toxic wastes, primarily at waste dump sites. PCBs have been used extensively in transformers and electrical capacitors. In many parts of the United States, discarded electrical equipment has released PCBs into nearby water supplies. Chloroform and pesticides have also been found in some municipal drinking water supplies.

Scientists are concerned that drinking even small quantities of these substances over time may have harmful effects. For example, drinking water contaminated with PCBs has been associated with kidney and liver damage. As a result of this toxicity, PCBs can no longer be used in electrical transformers.

- **Agricultural chemicals and wastes:** Water from rain or melted snow flows from farmland into streams, carrying chemical fertilizers and pesticides that have been used in farming. These toxins are especially dangerous because they have the ability to enter the food chain. Animals are unable to excrete the chemicals from their bodies, so the substances are stored in the animals' fat, organs and muscles. The concentration of toxins per unit of weight increases with each life form in the chain. By the time humans eat the fish that have fed on contaminated lower life forms, the toxic chemicals can be highly concentrated.

  Pesticides used in U.S. and Canadian agriculture are among the most toxic substances that can pollute the water supplies in the United States. Chlorinated hydrocarbons, such as DDT (now banned in the United States), chlordane and Kepone, have been linked to cancer, birth defects and reproductive system disorders.

The EPA estimates that almost two-thirds of rural Americans are drinking water contaminated with pesticides or other dangerous chemicals. This water is groundwater obtained by using wells. The EPA has listed seven hundred compounds considered dangerous in drinking water and has rated the level of pollution as serious in 34 states.

Agricultural use of fertilizers causes another type of water pollution—the depletion of oxygen in the water. Fertilizers draining off farmland add additional nutrients to a body of water. When this happens, the nutrients cause aquatic plants, such as algae, to grow very quickly, then die and decay.

The decaying process of the algae uses up much of the oxygen in the water and, as a result, fish and other animals suffocate. This process, which is called *eutrophication*, results in rivers, streams and lakes that can no longer support animal life. Eutrophication can also result from thermal pollution.

TESTING WATER QUALITY

The quality of a household's drinking water can be tested. The local water utility can provide information about available tests.

Controlling Water Pollution

Water pollution can be controlled by using three primary strategies:

- sewage treatment
- pretreatment of industrial wastes
- adopting safe drinking water standards

■ **Sewage treatment:** To be most efficient, sewage treatment should include three separate processes, which involve increasing amounts of purification: primary treatment, secondary treatment and tertiary treatment. Tertiary treatment makes effluent, the treated sewage, safer to discharge into waterways.

However, few treatment plants in the United States use all three methods of treatment. As a result, most treated sewage still contains chemicals and nutrients that can cause excessive algae growth and lead to eutrophication.

■ **Pretreatment of industrial wastes:** Industries can reduce pollution by removing harmful chemicals before dumping the wastes into waterways. Industrial wastes can also be reduced by using manufacturing processes that recover and reuse polluting chemicals.

■ **Adopting safe drinking water standards:** In 1974, the U.S. Congress passed the Safe Drinking Water Act to help protect the public water supply from pollution. Under this act, the EPA established uniform quality standards for about 240,000 public water systems in the United States. The aim was to reduce the amount of harmful bacteria, chemicals and metals in drinking water.

In 1979, the EPA issued rules limiting the amount of chloroforms and other related chemicals in the drinking water of large cities. When chlorine is added to drinking water to kill disease-causing bacteria, it reacts with other chemicals to produce chloroforms. These chemicals are thought to increase the risk of cancer when ingested over a period of time.

In addition to the EPA, the federally formed Council on Environmental Quality also makes recommendations about ways to handle environmental problems. State and local governments also take measures to protect the environment by enacting and enforcing laws that limit the amount of pollution from different sources.

Land Pollution

Land comprises only about 30% of the earth's surface. Of the total land mass, only a very small amount (2%) is inhabited by humans. The rest is covered by forests and woodlands, is used for agriculture and domestic animals, or is unusable (for example, is under permanent ice or is extremely mountainous). Thus, the land we live on is a precious resource that must not be taken for granted.

Land pollution damages the thin layer of fertile soil that covers much of the earth's land surface and is needed for growing food. In only a few years, poor treatment can destroy soil that took thousands of years to form.

Sources of Land Pollution

Land can be polluted by chemicals such as fertilizers and pesticides and by solid waste.

In nature, plant and animal wastes, including dead organisms, accumulate in the soil. Bacteria and fungi decay these wastes in a natural cycle, breaking them down into nutrients such as nitrates and phosphates. These nutrients feed growing plants. When the plants die, the cycle begins again.

Fertilizers and pesticides help people to grow more and better crops. Fertilizers add extra nutrients to the soil and increase the amount of a crop that can be grown on a plot of land. However, the use of fertilizers may decrease the ability of bacteria to decay wastes and produce nutrients as part of the natural cycle.

Pesticides destroy weeds and insects that harm crops, but pesticides may also harm bacteria and other helpful organisms that live in the soil. Pesticides can also leave a hazardous residue on plants eaten by humans.

People exposed to greater amounts of pesticides can suffer serious health problems or can even die. An example of this type of exposure occurred in Bhopal, India, in 1984. A pesticide factory emitted excessive vapor into the air of nearby neighborhoods, killing more than two thousand people and injuring almost a hundred thousand more. While this example is extreme, it demonstrates the need to take great care in producing and using such chemicals.

In the United States, farmers and farm workers are at increased risk of pesticide-related health problems through their daily exposure to pesticides.

Solid waste is probably the most visible form of pollution. Solid waste refers to any type of nonliquid refuse or trash that people discard. Solid waste litters roadsides, floats in lakes and streams and collects in dumps. Examples of solid waste include paper, food, glass, plastic and metal; junked automobiles, tires, appliances and furniture; and agricultural and industrial wastes.

During the past few decades, the amount of solid waste has greatly increased. In the United States, about 2 billion tons of waste are produced each year. Most of the waste is generated by agriculture, mining and industry, rather than by individual households.

Solid waste presents a serious problem, because most of the methods used to dispose of it cause some type of damage to the environment or to human health. The major methods of disposal include:

- open dumping
- ocean dumping
- sanitary landfills
- incineration

- **Open dumping** involves compaction and dumping of solid waste at a dump site. Dumps can provide homes for disease-carrying animals, such as cockroaches and rats. This method of disposal is now discouraged or illegal in many urban areas.

- In **ocean dumping,** solid waste is taken to offshore dump sites. Marine biologists worry that this practice contributes to water pollution and changes the habitat of many marine plants and fish. Increased environmental awareness has led to the development of other, more controlled methods of solid waste disposal.

- **Sanitary landfills** are specially planned and supervised disposal sites where waste is disposed of in pits. Each day, a layer of soil is pushed over the most recently dumped trash to encourage decomposition, reduce odors and contain the material. This method of disposal is the most common.

  This type of disposal also has drawbacks. Harmful substances can seep into the ground and contaminate soil or water. More and more items are being produced that are difficult to dispose of, such as aluminum cans that stay in their original state for many years and plastics that will not decay. In addition, available space for these landfills is becoming increasingly scarce.

- **Incineration** involves burning waste in specially designed furnaces. Materials are burned at very high temperatures, converting them to gases and leaving small amounts of residue that can be disposed of in landfills. Incineration reduces the volume of waste and can be used to generate electricity or steam for heating. However, burning produces smoke that causes air pollution.

Controlling Land Pollution

There are two ways to reduce solid waste: to reduce it at its source and to recycle the materials. These methods involve reducing or reusing packaging, or using packaging materials that are biodegradable. Biodegradable products decompose naturally in the environment.

Recycling involves converting disposable items into reusable materials. Some municipal areas have begun curbside pickup of recyclable materials, especially glass, aluminum and newspaper. To be most effective, recycling requires planning, locating markets for recycled materials, gaining community or government support, and soliciting the active participation of individuals and households.

Disposal of hazardous chemicals is becoming a serious problem. There are now more than thirty thousand toxic-waste dump sites in the United States. Due to the cost of detoxifying, recycling and reusing toxic chemical products, chemical companies have often secretly and illegally buried their chemical wastes at dump sites. Because of this problem, the EPA is helping to fund the cleanup of some of the toxic waste disposal sites in various parts of the country. Court decisions also have ordered some companies to clean up dump sites and pay fines.

Radiation

Radiation is an invisible pollutant that can be extremely dangerous. The term *radiation* includes several kinds of energy, some that occur naturally in the environment and some that are created by humans.

Types of Radiation

The term *radiation* is usually used to mean *ionizing radiation*, which produces electrically charged particles called ions in the molecules it strikes. Sources include X-rays, radioactivity and cosmic rays. *Nonionizing radiation*, the other major type, does not produce ions. Microwaves, magnetic fields and UV rays are examples of nonionizing radiation.

- **Ionizing radiation:** Although radiation has been important to the development of industrial and medical technology, there are health concerns about exposure to radiation, especially exposure to ionizing radiation. Overexposure to ionizing radiation can cause cancer, birth defects and damage to the immune system.

  Naturally occurring sources of ionizing radiation include:

  - cosmic rays from the sun and the outer universe
  - rocks or soil containing radioactive mineral deposits
  - radon gas released from underlying rock formations and stone building materials

  Human activity has created other sources of ionizing radiation, such as medical X-rays, nuclear reactors and nuclear weapons. Nuclear radiation is potentially harmful, if it leaks out as a result of human error or equipment failure when operating a reactor. Reactors also produce nuclear wastes that require disposal. No radiation disposal methods are completely safe. Scientists are studying ways to dispose of these wastes safely and permanently. The threat of mass exposure to ionizing radiation is one of the many serious risks associated with the production and dismantling of nuclear weapons.

- **Nonionizing radiation:** Nonionizing radiation also comes from both natural and artificial sources. A natural source is ultraviolet (UV) light from the sun. Most UV radiation is absorbed by the ozone layer in the atmosphere, although the depletion of this layer by air pollution is allowing more UV rays to reach the earth. Higher levels of UV radiation increase the risk of skin cancer and damage to the immune system.

  Another type of nonionizing radiation is *electromagnetic* radiation, from appliances such as microwave ovens, televisions and computer visual display terminals (VDTs). Some medical testing procedures, including ultrasound and magnetic resonance imaging (MRI), use equipment that emits nonionizing radiation. The magnetic fields around wires carrying electricity also emit this radiation. Scientists disagree about the health risks of exposure to electromagnetic radiation and have not determined exactly what effects this exposure may have on humans.

- **Radon gas:** Radon gas is a colorless and odorless radioactive gas produced naturally when uranium decays. It occurs in certain soils, rocks and groundwater and is emitted by building materials made from these soils or rocks. While harmless in the open air, radon is unsafe when it accumulates in enclosed spaces, especially when air is stagnant.

  Energy-efficient, "air-tight" buildings have been shown to be most affected. The gas enters buildings through a variety of routes, including cracks in the floor, drains and slab joints.

  According to recent studies, prolonged exposure to radon can increase a person's risk of developing lung cancer. The combination of smoking and exposure to radon is particularly lethal.

Controlling Radiation

A number of devices can be used to measure radon levels. Home testing kits are available, and there are licensed testing companies. If levels are high, some minor structural modifications can be made to the building to reduce them.

International agreements and regulations banning most testing of nuclear weapons in the atmosphere have helped to eliminate major sources of radiation.

Noise Pollution

Noise pollution is any loud or annoying sound that is present in a person's environment. Noise loudness is measured using units called *decibels*. A soft whisper measures about 30 decibels, a lawn mower about 90 decibels and a jet airplane taking off at close range about 160 decibels. In general, the louder and higher the pitch, the more annoying and unpleasant the sound.

Prolonged exposure to noise affects health and may cause hearing loss. Noise is considered to be a physical and psychological stressor. Exposure to loud noise can cause increases in blood pressure, heart and respiration rates, cholesterol and hormone levels, and muscle tension.

Noise can also produce emotional effects such as irritability and inability to concentrate. Some studies suggest a link between excessive noise in the workplace and rates of unintentional injury.

People can also be exposed to excessive noise through the use of headphones and speakers and attendance at rock concerts. Although intentional, such exposures also have adverse effects, including hearing loss.

Controlling Noise Pollution

Many communities have enacted local ordinances to control noise. Individuals can take the following actions to help protect themselves from noise pollution:

- Use earplugs or ear protectors when operating loud machinery, attending loud concerts or participating in sports that produce loud noises, such as skeet shooting and motorcycle racing.
- Use sound-absorbing building materials.
- Encourage the adoption of noise-reduction ordinances to control noise levels from machinery and other sources.

1-Minute Facts

- The environment is a critical factor in the health of individuals and communities.
- Environmental pollution refers to all the ways that people pollute or contaminate their surroundings.
- Air pollution is a major problem in modern society.
- Water pollution can be caused by both natural processes and human activity.
- The land we live on is a precious resource that must not be taken for granted.
- Radiation is an invisible pollutant that can be extremely dangerous.
- Noise pollution is any loud or annoying sound that is present in a person's environment.

Natural Environmental Cycles

Myth: Burning fossil fuels such as coal isn't really a problem, because growing plants use the carbon dioxide and water produced by the combustion.

Fact: Plants do use carbon dioxide, but overuse of fossil fuels can exceed the carbon cycle's capacity to handle the carbon dioxide. Using renewable resources such as solar energy helps maintain the carbon balance.

To fully comprehend how pollution of air, water and soil damages the environment, it is helpful to understand the natural processes that are disrupted when pollution occurs. In nature, regular cycles keep the different environmental components in balance. In these cycles, certain chemical elements are recycled so that they can be used over and over again.

This process is necessary because the vital nutrients that support life on earth are basically from the same pool of elements that has been supporting life for more than 3 billion years. The earth must depend upon this same pool of nutrients into the indefinite future.

The term *nutrients* refers to all the chemical building blocks of life. Some examples of the nutrients required in large quantities are water (a chemical compound) and the elements carbon, hydrogen, oxygen, nitrogen, phosphorus and calcium. Many other nutrients are also needed, but only in trace quantities.

Natural environmental cycles, or *nutrient cycles*, describe the pathways these substances take as they move from the living to the nonliving parts of the environment and back again. The major source of nutrients is the nonliving environment. For example: The major source of carbon is the atmosphere and the oceans; nitrogen comes mainly from the atmosphere; and most water is found in the oceans. Microorganisms also are a part of the cycles; without their activities, essential elements would become depleted and all life would cease.

Air and Soil Cycles

Two main cycles are related to the air and the soil: the carbon cycle and the nitrogen cycle.

- **The carbon cycle:** All organic material contains carbon. Most of the carbon comes from the carbon dioxide in the atmosphere. Some carbon dioxide also is dissolved in water.

  Carbon dioxide (CO_2) is a colorless, odorless gas that occurs naturally in the atmospheres of many planets, including Earth. It comprises less than 1% of the gases in the earth's atmosphere. All green plants need carbon dioxide for *photosynthesis*.

  Through photosynthesis, plants absorb carbon dioxide to make sugar and give off oxygen. People and animals inhale oxygen and exhale carbon dioxide. Through this cycle, the supply of oxygen and carbon dioxide stays fairly stable.

Animals also release carbon dioxide when they excrete wastes and when they die. This process is aided by microorganisms such as bacteria and fungi, which decay the organic material, helping to keep the soil fertile and to release carbon dioxide into the atmosphere.

Carbon dioxide is important in regulating the earth's temperature. When sunlight reaches the earth, some of it is converted into heat. The carbon dioxide in the atmosphere absorbs some of the heat, helping it stay near the earth's surface. If the heat created by the sun were allowed to escape into outer space, the earth would become very cold.

Carbon dioxide is used both in homes and in industry. Carbon dioxide gives soft drinks, beer and sparkling wines their fizz; it is released by baking powder and yeast to make dough rise; and it is used to help extinguish fires.

Since about 1890, as a result of the burning of fuels that contain carbon, the amount of carbon dioxide in the atmosphere has been increasing. This increase has caused the average temperature of the earth to rise slightly—the "greenhouse effect."

- **The nitrogen cycle:** All living things need nitrogen. Nitrogen makes up almost 80% of the earth's atmosphere, but most organisms cannot use nitrogen in this gaseous form. They need nitrogen that has combined with certain other elements, and the supply of this "fixed" nitrogen is limited.

  A complex method of recycling nitrogen has developed in nature. In this cycle, bacteria and blue-green algae convert nitrogen into fixed nitrogen in a process called *nitrogen fixation.*

  One part of the nitrogen cycle involves the circulation of nitrogen between the soil and living things. In this part of the cycle, nitrogen is changed into ammonia, nitrites and nitrates. Plants absorb some of the ammonia and nitrates, using them to make proteins and other substances that are essential to life. Animals get nitrogen by eating plants or by eating other animals that eat plants.

In another part of the cycle, the nitrogen-fixation process constantly puts additional nitrogen into forms that other living things can use. Bacteria living in soil, water or plants convert nitrogen in the atmosphere into nitrogen-containing organic substances.

While nitrogen fixation is converting nitrogen into usable organic compounds, another process returns an approximately equal amount of nitrogen back to the atmosphere. Fixed nitrogen can circulate many times among organisms before being returned to the atmosphere. This continuous return of nitrogen to the atmosphere balances the cycle.

The Water Cycle

The water, or *hydrologic*, cycle differs from other nutrient cycles because most water remains unchanged throughout the cycle. The major reservoir of water is the ocean, which covers about three-quarters of the earth's surface and contains about 97% of the earth's available water.

The water cycle is driven by solar energy, which evaporates water, and by gravity, which draws water back to earth as precipitation. Water comes back to earth as rain, snow, sleet and dew, as well as other forms. Most evaporation comes from the ocean, and much water returns to the ocean as precipitation.

Water that falls on land can take a variety of courses. Some is evaporated from the soil and from rivers, lakes and streams. Some runs off the land back to the ocean, and a small amount enters underground reservoirs and becomes part of the groundwater supply.

Since living things contain about 70% water, some of the water enters the living portion of the ecosystem. It is absorbed by the roots of plants and then evaporated back to the atmosphere from their leaves. A small amount is used for photosynthesis.

Although the water cycle does not require living things in order to function, communities of living things depend on these patterns of evaporation and precipitation. In fact, a community's way of life is often determined to a great extent by these patterns. For example, the types of communities found in a desert are very different from those functioning in a tropical rainforest. These differences reflect the differences in the timing and amount of water found in these ecosystems.

Water, Water

- Only about 3% of the earth's water is fresh. Most of this water is frozen in glaciers.
- All living things consist mostly of water.
- In a lifetime, the average person takes in about 16,000 gallons of water.
- Water is never used up; it is used and reused over and over again. Every glass of water a person drinks contains molecules of water that have been used countless times before.

Pollution and Natural Cycles

Pollutants contaminate the air, water or soil, interfering with the natural cycles in the environment. With respect to these cycles, pollutants can be categorized as one of three types:

- substances produced by living things and natural events (e.g., carbon dioxide, animal waste products and sediments that enter waterways from the land)
- substances that occur naturally on earth but are not normally free in the environment (e.g., radioactive materials, lead and asbestos)
- synthetic compounds created by humans (e.g., pesticides and PCBs)

These materials pollute the environment by entering ecosystems and disrupting the normal relationships and interactions. Pollutants disrupt the natural cycles in two major ways.

One way is by flooding a natural cycle with more material than the cycle can process. This situation occurs with pollutants that are potential nutrients. They occur naturally in the environment but are produced in excess by humans.

The second way pollutants disrupt natural cycles is by poisoning the cycle with substances that are not normally available in the environment. As a result, most organisms have not evolved the capability to use these substances or to break them down.

Flooding the Natural Cycles

An excess of natural substances in the environment can come from industrial processes, from activities that concentrate the substances in one place, or from human populations that have grown too large for their ecosystem to handle. For example, volcanoes produce sulfur dioxide, but power plants and industries produce more than ten times the amount that comes from all natural sources, including volcanoes.

Examples of situations in which the natural cycles are overwhelmed by the release of an excess of nutrients include the following types of pollution:

- eutrophication of lakes and streams
- acid rain
- the greenhouse effect

■ **Eutrophication of lakes and streams:** Lakes and streams naturally occur as clear, because the water is low in nutrients, which limits the growth of algae and other life forms. When water rich in nutrients, for example, water discharged from a sewage plant or water washed off fertilized farmlands or feed lots, is added to a clear lake or stream, a sudden explosive growth of algae and bacteria results. These

algae and bacteria cloud the water, forming a scum on the surface that blocks sunlight from reaching plants living under water.

This process of adding excessive nutrients is called *eutrophication*. The term *eutrophication* comes from the Greek, meaning "feeding well"—too well, in this case. The increased growth of microscopic plant life overwhelms the ecosystem; the plants and bacteria die faster than they can be consumed by animal life. They decompose, thereby depleting the limited amount of oxygen dissolved in the water.

The depletion of oxygen causes fish and other aquatic life to die, and their decomposition further fuels the growth of bacteria and the reduction of the oxygen supply. Foul-smelling gases, such as hydrogen sulfide (which produces a "rotten egg" smell), develop as the water becomes dominated by the bacteria and algae.

If the influx is stopped, bodies of water can slowly recover. Over time, the nutrients become trapped in bottom sediments and become less accessible to the algae and bacteria.

- **Acid rain:** Sulfur and nitrogen are essential to life. However, the discharge into the atmosphere of sulfur dioxide and nitrogen oxides from power plants, transportation sources and industries has resulted in the development of acid rain. When sulfur dioxide and nitrogen oxides combine with water vapor in the atmosphere, they are converted to acids.

  Most of the acid rain in the United States is caused by sulfur dioxide from Midwestern power plants that burn coal. Once the acids are formed, winds carry them to all parts of the country. Some areas of the country have rock that is rich in calcium carbonate, a natural buffer for acidity. But in some areas, such as New England, hard rock such as granite and basalt predominates, which cannot counteract the acid rain. These areas are particularly vulnerable.

Acid rain that falls on lakes kills aquatic life. It also interferes with the growth and yield of farm crops. Acidic water percolating through the soil leaches out important nutrients and dissolves normally inert toxic metals. Plants then absorb the metals, which kill the microorganisms essential for decomposing the plant material and returning the nutrients to the soil.

As plants weaken from being poisoned and deprived of nutrients, they are more susceptible to infections by fungi and bacteria and to attack by insects. In this way, acid rain is thought to be devastating many forests worldwide. Pollution control programs are aimed at stopping this damage.

A serious danger to human health is the increased exposure to toxic metals caused by acid rain. While these metals are relatively inert in natural ecosystems, many are more soluble in acidic conditions. When the metal ions are taken up by life forms all along the food chain, they can reach dangerous levels by the time humans are involved.

Fish in acidified water have been found to have high levels of mercury in their bodies, even though they were far from any known source of mercury. The combination of acid and mercury forms an extremely toxic compound that is taken in by fish and other organisms, accumulating to dangerous levels as it moves along the food chain.

Acid rain has increased human exposure to lead. In some households, drinking water has been found to be dangerously contaminated with lead dissolved from lead pipes by acid water. The state of Massachusetts spends $1 million a year to add chemicals to Boston's water supply to counteract the acidity.

- **Greenhouse effect:** Like sulfur and nitrogen, carbon and oxygen are essential to life. Millions of years ago, under unique environmental conditions, huge amounts of carbon were diverted from the carbon cycle and converted to fossil fuels, such as coal, oil and natural gas. Since the Industrial Revolution, human societies increasingly have relied on the

energy stored in these fuels. As the fuels are burned in power plants, industries and motor vehicles, carbon dioxide is released into the atmosphere, "flooding" the natural carbon cycle.

Another important way the carbon cycle is flooded is by deforestation. Millions of acres of forests are cut each year worldwide. This deforestation is occurring mainly in the tropics, where rain forests are being cut down as a way of increasing agricultural land for expanding human populations.

Trees absorb large amounts of carbon dioxide. When they are cut down, much of the carbon stored in these trees eventually returns to the atmosphere, through burning or decomposition.

Flooding the carbon cycle has an important consequence. Normal amounts of carbon dioxide contribute to a natural greenhouse effect, helping to trap heat on the earth that is necessary for sustaining life. Without the natural greenhouse effect, the earth would be cold and lifeless.

However, this natural effect of carbon dioxide, once a stabilizing and beneficial aspect, is now becoming dangerous, as the greenhouse blanket of gases becomes thicker from too much carbon dioxide. As the levels of carbon dioxide rise, the earth's temperature gradually increases.

This phenomenon is also called *global warming*. Although exactly how much the earth will heat up is unknown, the EPA has predicted a rise of about four degrees Centigrade by the middle of the next century. Although this seems like a small increase, in the past million years the earth's temperature has changed by only six or seven degrees Centigrade, and this change included the comings and goings of ice ages.

If allowed to continue, this global warming trend will adversely affect all life on earth. Rainfall patterns will change in unpredictable ways, even with only small temperature changes. Rainfall changes could mean that some land currently cultivated with irrigation might become too dry for

agriculture. Other areas could receive more rain than in the past. Since agricultural practices worldwide are attuned to local climate and rainfall, these changes could be devastating.

Since it is unclear exactly what the consequences of global warming will be, it is difficult for governments to take the drastic measures that would be needed to stop the trend. However, it is clear that for the first time in the earth's 5-billion-year history, human beings, which represent a single species, are progressively changing the earth's climate.

Poisoning the Natural Cycles

In addition to flooding the environment with substances that are life-sustaining in smaller amounts, human activities are also exposing the environment to a variety of "foreign" substances. Some of these substances occur naturally. Others are toxic synthetic compounds, such as dioxin, that have been formed both intentionally and as byproducts in the production of other substances. Once many of these compounds get into the environment, they are difficult, if not impossible, to remove.

Lead and asbestos are examples of toxic minerals that have contaminated the environment through human use, although their use is being phased out.

- **Lead** has entered communities through the use of leaded gasoline, fossil fuels and household paint. While its use is being phased out, it is still a contaminant. Houses were painted with lead-based paint up until the early 1960s.

  Particularly in inner cities with very old houses, lead is still a threat, especially to the health of children. Lead interferes with blood cell production and affects the central nervous system. Children are especially vulnerable, because their nervous systems are still developing. Many children have developed lead poisoning from consuming flakes of lead-based paint as it peeled off walls.

Lead poisoning causes weakness of the extremities, slowed reflexes, anemia and nausea. But in children, even lower levels of lead in the blood have been associated with learning disabilities and hyperactivity.

- **Asbestos** has been widely used for insulation and fireproofing because of its heat-resistant properties. Asbestos exposure has been linked with two deadly diseases, *asbestosis* (a condition similar to emphysema) and *mesothelioma* (a fatal cancer of the membranes around the lungs). Unlike some poisons that require prolonged exposure to develop disease, airborne asbestos can trigger cancer with only brief contact.

- **Dioxin** is one example of a harmful synthetic compound. Dioxin is a byproduct of the production of pesticides and other substances. It is highly toxic and causes cancer and birth defects in laboratory animals. People exposed to dioxin have developed skin problems, liver damage and nervous system disorders.

  In the early 1980s, the town of Times Beach, Missouri, was found to be heavily contaminated with dioxin 11 years after its streets had been treated with dioxin-contaminated oil to control the dust. The federal government evacuated the town and bought the homes of all its residents. At Love Canal in New York, dioxin was found where tons of chemical wastes were buried.

  Thousands of Vietnam veterans have filed disability claims based on exposure to dioxin-contaminated Agent Orange, an herbicide used as a defoliant during the Vietnam War. In Vietnam, scientists reported a threefold increase in birth defects among children of fathers exposed to Agent Orange. In the United States, traces of dioxin are still contaminating herbicides used in agriculture.

  Dioxin is a substance that is not broken down by decomposer organisms in the soil. Once it is put there, it stays there. Because it is stored in fat when it is consumed

by humans or other animals, it has the potential to *bioaccumulate*, or to accumulate in increasing amounts along the food chain.

Dioxin and other synthetic chemicals known to be toxic, such as DDT and PCBs, are no longer widely used in the United States. However, each year, more than 2,000 new compounds are introduced into the environment. Some of these are likely to be found to be similarly dangerous to human and other populations.

Increased awareness of this possibility has led to more careful screening of new chemicals and a wariness of indiscriminate use. However, more controls are needed in this area.

The Impact of Human Activity on Ecosystems

Ecosystems dominated by humans share some general characteristics that differ from the characteristics of undisturbed ecosystems.

- **Ecosystems dominated by humans tend to have less diversity of species.** These ecosystems have been artificially "simplified" in order to make way for agriculture and other human needs. Existing species and ecosystems have been eliminated or driven out by human development. While many benefits are gained by this simplification, it is crucial to preserve intact as many natural communities as possible.

  Undisturbed forests trap and purify water and can reduce air pollution. Coastal wetlands are breeding places for birds and spawning sites for most commercially important fish. Undisturbed ecosystems provide a storehouse of species that may be of value to people, such as medicinal plants. These environments also offer aesthetic pleasure.

- **Human ecosystems depend heavily on nonrenewable energy, mostly from fossil fuels.** The use of better insulation and solar heat can dramatically save energy. Using renewable energy sources, such as wind and sunlight, helps to conserve fossil fuels, reduce pollution, and move human ecosystems closer to naturally occurring cycles.

- **Natural ecosystems recycle elements; human ecosystems tend to lose them.** For example, in farming, natural cycles are disrupted by erosion and use of pesticides. With erosion, crucial plant nutrients are removed and large amounts of fertilizer are needed to replace them.

  Pesticides may kill natural decomposers, which robs the soil of needed nutrients. In many natural ecosystems, fertile soil accumulates, but in those dominated by humans, fertile soil tends to be lost. Adopting specific farming techniques can help to counteract this problem.

- **Natural ecosystems store and purify water; human ecosystems lose and pollute it.** Preventing erosion and recycling products such as manure from cattle feed lots (a significant source of both groundwater and surface water pollution) would help to preserve water and avoid pollution.

- **Simple human ecosystems tend to be unstable.** These systems are not balanced and lack the controls offered in nature, for example, the control of insects by natural predators.

- **Natural ecosystems have natural population controls, while human population growth becomes a problem.** Unchecked population growth can result in serious problems, including poverty and the depletion of natural resources.

1-Minute Facts

- Regular cycles in nature keep the different environmental components in balance.
- The carbon cycle and the nitrogen cycle are related to the air and the soil.
- The ocean contains about 97% of the earth's available water.
- Some of the most serious pollutants are natural substances in the environment that are produced in excess by human populations.
- Human activities expose communities to substances that poison the natural cycles.
- Ecosystems dominated by humans differ from undisturbed ecosystems.

Protecting the Environment

Myth: Environmental advocacy groups will protect the environment.

Fact: Protecting the environment requires that governments, industries, organizations and individuals work together. Protecting the environment is a worldwide issue. For this reason, it is important to "think globally and act locally."

The natural environment is a complex system of interrelated parts. Protecting that environment requires action on many different levels—from the international to the individual.

Government Policy

In the United States, federal, state and local governments have taken steps to control pollution. These governments have passed laws limiting the amount of pollutants that industries, sewage treatment plants and motor vehicles can emit into the environment. They support research on environmental issues and fund antipollution programs (such as curbside recycling).

The Federal Government

Although problems with pollution began developing long ago, it wasn't until the 1960s that significant legislation was passed to help protect the environment. During and since the 1960s, much legislation has been passed to deal with all types of pollution.

In 1970, the Environmental Protection Agency (EPA) was formed as an independent federal agency. It combined 15 separate federal programs into one. The EPA is empowered to set and enforce pollution standards, conduct research, and help state and local governments with pollution control. The agency is directly responsible to the president of the United States.

Also in 1970, the National Environmental Policy Act (NEPA) was signed into law. NEPA requires all federal agencies to prepare environmental assessments or environmental impact reports on their programs and projects. These analyses are required to take a close look at the possible environmental consequences of proposed actions.

Under NEPA, citizens who could be affected by federal projects have the right to assurance that any environmental harm that a project could cause will be adequately assessed and made public before the project legally can begin. Because of the broad way that "federal" is defined under this law, many private and state projects must comply with NEPA's requirements.

State and Local Governments

Most state and local governments have developed some type of pollution control program. Programs vary widely depending on the type and seriousness of the problems in each area. Typically, state and local laws prohibit activities such as burning trash in the open air and dumping untreated sewage into water. Some areas have begun programs to deal with pollution that originates in one state and affects another.

Landmark Environmental Laws

- The Clean Air Act of 1970
- The Clean Water Act of 1972
- The Federal Insecticide, Fungicide, and Rodenticide Act of 1972 (deals with pesticide distribution, sale and use)
- The Resource Conservation and Recovery Act of 1976 (the first comprehensive effort to deal with solid waste and hazardous waste products)
- The Toxic Substances Control Act of 1976
- Superfund—The Comprehensive Environmental Response, Compensation, and Liability Act of 1980

Most of these laws were revised and strengthened in later years.

International Controls

Most other industrial nations also have taken action to control pollution. Countries with environmental problems similar to those in the United States include Canada, Japan and many European countries. In some places, international agreements on pollution control are being developed, such as an international treaty limiting production of chlorofluorocarbons (CFCs).

In many industrial countries, political parties representing environmental concerns have formed. These organizations are often known as "Green" parties. In Western Europe, Green parties have had a growing influence on environmental policies.

Ozone Protection: A Case of Effective Collaboration

In 1987, an international convention was held to discuss potential solutions to the problem of ozone depletion. A result of the convention was the Montreal Protocol, which called for reducing the production of CFCs by 50% by the year 1998.

More recently, several industrial countries, including the United States, called for totally phasing out the use of CFCs by the year 2000. Dupont Corporation, the world's largest producer of CFCs, announced that it plans to phase out its use of CFCs by that time.

A study reported in 1993 found that worldwide emissions of CFCs were being reduced even sooner than expected. This reduction was attributed to industry's unexpectedly rapid cut in production of CFCs even before the international agreements to phase them out took full effect.

The effort to reduce the use of ozone-destroying chemicals is considered an example of effective government and industry response to an environmental threat.

Industry and Agriculture

Many pollution problems have developed because methods of preventing pollution are costly. Practices such as reusing waste products have not been used as often as they could be, partly because of the high cost of adjusting manufacturing or agricultural activities to reprocess the waste products. The challenge is to find a balance between the need to grow economically and the need to protect the environment.

Industry

In industry, the use of sulfur is an example of a pollutant that is allowed to exist for economic reasons. Sulfur is released as sulfur dioxide when coal is burned. In the United States, industries that use coal for fuel emit millions of tons of sulfur dioxide into the atmosphere each year.

Most of the sulfur in industrial smoke could be captured and reused to produce sulfuric acid (a widely used industrial chemical) if a practical or economical method for capturing the sulfur existed. Until such a method is developed, industry will find it easier and cheaper to mine new supplies of sulfur than to recycle the sulfur in industrial smoke.

SULFUR POLLUTION

The United States is the world's largest producer of the sulfur dioxides and nitrogen oxides that lead to acid rain. According to some experts, as many as 50,000 people a year die prematurely as a result of airborne sulfates in the United States, about the same number of deaths as result from automobile crashes.

Agriculture

In farming, an example of a practice that is economical but that generates pollution is the use of feed lots, or large pens, in raising livestock. When livestock graze on large areas of land, their waste products become part of the natural cycles that fertilize the land. However, farmland is often too valuable to use for livestock grazing. It is more profitable to use the land for raising crops and to keep livestock in feed lots.

Livestock that are kept in a feed lot deposit large amounts of waste in a relatively small area. The soil cannot absorb all the waste, and much of it runs off the land and pollutes nearby bodies of water. In addition, because the farmland is not being fertilized naturally with livestock wastes, farmers must apply chemical fertilizers. These, too, may run off the land and pollute water.

PESTICIDE PROBLEMS

Ninety percent of the pesticides used for agriculture have never been tested for long-term health effects. About 50,000 cases of pesticide poisoning are recorded each year in the United States.

Approaches to Controlling Pollution

Several approaches can be used to control pollution. In most cases, effective programs to prevent pollution can make great improvements in the environment. The following three approaches are important:

- recycling
- developing new technology
- restricting the use of pollutants

■ **Recycling:** This process is designed to recover and reuse materials instead of throwing them away. It involves reprocessing waste products in order to reuse them.

Recycling helps conserve raw materials that manufacturers would otherwise need to use. It keeps used materials out of landfills, helping to reduce pollution from the disposal of waste materials.

Commonly recycled materials include aluminum and steel cans, glass containers and paper. Plastic, used motor oil and automobile tires are also recycled.

Some materials, such as cans and newspapers, can be reused over and over again for the same purposes. Cans are melted down and used to make new cans. Old newspapers are turned into pulp and made into clean newsprint.

Other materials are reused for different purposes. For example: Ground-up glass is an ingredient in road-building materials. Recycled paper can be used not only for making

paper and cardboard, but also in manufacturing building materials such as insulation and plasterboard. Food and yard waste can be recycled into mulch by composting.

Recycling has been an important source of materials for iron and steel industries and paper manufacturers since the early 1900s. Since the 1960s, the growing concern about dwindling natural resources and the increase in environmental pollution have led to renewed interest in recycling.

Recyclable materials have the most value when they are sorted and collected separately from garbage. Separating them at a waste-processing plant is complicated and expensive.

Recyclable materials can be collected in three basic ways: buy-back centers, drop-off centers and curbside recycling programs. In buy-back centers, people are paid for their recyclables. Drop-off centers do not pay for materials. In curbside recycling programs, community residents separate their materials, which are picked up by trucks and taken to manufacturers who convert them back into usable products.

Many schools, businesses and industries also have recycling programs. Schools and offices can recycle paper products, for example.

Recycling Makes A Difference

- A recycled soda can saves 95% of the energy needed to make a new can.
- To produce each Sunday's newspapers, it takes about 500,000 trees for the 88% of newspapers that aren't recycled.
- Americans throw away enough iron and steel to continuously supply all the nation's automakers.
- Americans dispose of enough aluminum to rebuild the entire commercial air fleet every three months.

- **Developing new technology:** New technological developments can be used to control pollution caused by older technology. For example: Several types of devices have been developed to keep particulates from leaving industrial smokestacks. Pollution from motor vehicles can be reduced by using new additives in gasoline and devices that remove pollutants from exhaust.

  In agriculture, the use of biological controls instead of pesticides is an important way of controlling pollution. Biological controls use natural ways to control pests, such as various types of insects and bacteria.

- **Restricting the use of pollutants:** Restricting the use of substances that cause pollution can be extremely effective, but the restrictions may require changes in ways that people live and may cause inconvenience.

  An example of effective use of this method of controlling pollution is DDT. Most industrial countries have banned the use of DDT, and farmers have found other, less harmful pesticides to replace it.

  Unleaded gasoline is now produced because lead was found to be a major pollutant in motor vehicle exhausts. Motor vehicle engines had to be modified so that the engines could run properly on unleaded gasoline.

  Restrictions can cause major problems if acceptable alternatives are not created. For example, banning private automobiles in crowded downtown areas would be problematic if effective and accessible mass transportation systems were not in place.

Taking Environmental Action

In addition to governmental agencies, groups of individuals have formed organizations to fight problems that affect the quality of the environment. Individuals can also take steps to help preserve the environment.

Private Organizations

Some environmental groups are concerned with local problems, but many also work on regional, national and global environmental issues. These groups provide education, lobbying or actual clean-up work. Often they call public attention to pollution problems and put pressure on governments and industries to control pollution. This pressure has been responsible for much of the action taken to protect the environment.

Each year, millions of people celebrate Earth Day on April 22. The purpose of Earth Day is to increase public awareness of environmental problems.

Individuals

The magnitude of environmental problems can seem overwhelming. It is easy for people to become discouraged about their ability as individuals to have an effect. But when many people take one simple action, the cumulative effects can be great.

Individuals can take the following steps:

- Recycle whenever possible.
- Evaluate labels and look for the recycled symbol on packages.
- Select detergents that are phosphate-free.
- Avoid products that contain harmful materials or are packed in Styrofoam.
- Buy items with less packaging, in bulk quantities, in recyclable containers.
- Avoid disposable items.
- Use energy-efficient light bulbs, cars and appliances.

- Critically evaluate advertising claims that a product is safe for the environment.
- Conserve water.
- Dispose of hazardous chemicals properly.
- Compost yard waste.

1-Minute Facts

- Protecting the environment is a worldwide issue.
- In the United States, federal, state and local governments have taken steps to control pollution.
- Many pollution problems have developed because methods of preventing pollution are costly.
- Effective programs to prevent pollution can make great improvements in the environment.
- Many private organizations work on regional, national and global environmental issues.
- Steps taken by individuals can help protect the environment.

Part II: Community Health

KEEPING COMMUNITIES HEALTHY— PRINCIPLES AND APPROACHES

MYTH: Community health is the responsibility of governmental agencies.

Fact: Governments are only partially responsible for fostering community health. A healthy community also requires educational, social and environmental actions on a local level that examine individual and group behaviors and lifestyle choices in larger contexts.

Some health problems are highly personal, requiring individual action for prevention or treatment. But many health benefits can be obtained only through collective action within a community.

Promoting the health of communities involves educational, social and environmental actions that enhance the health of people living in a specific area. Educational efforts may address high-risk individuals, families or groups; decision-makers; or entire communities. Social actions can include economic, political, legal and organizational changes designed for health promotion. Environmental supports include the physical, chemical and biological resources needed to protect a community's health.

While *public health* generally refers to the work of official governmental agencies, *community health* emphasizes the local efforts of public and private sectors working together.

Today, health promotion is a major focus, as health care providers recognize that behavior and lifestyle choices are the key to preventing or controlling leading causes of death and illness. These choices must be addressed within their historical, social, cultural, economic and community contexts.

Threats to Community Health

The health of a community is affected by four general categories of factors:

- human biology
- environment
- lifestyle choices
- health care organization

■ **Human biology** includes health outcomes that result from genetics, natural growth and aging. Although they must be considered, biological factors cannot be greatly altered by individuals or communities.

- The **environment** includes everything related to health that is external to the human body. While the individual has limited control over these factors, a community may be able to exert more control over them, for example, ensuring that the community has safe water to drink or effective garbage and sewage disposal.

  A community's environment has physical, social, cultural and economic components. Physical aspects include such things as geography, climate, community size, neighborhood organization and industrial conditions.

  The health problems of people living in a residential community may be very different from those of people living in a more industrialized area. An industry that produces a lot of noise, such as an airport, may create special kinds of problems. Mining communities in which people live with the fear of extreme occupational hazards face different challenges than communities in which industrial injuries are rare.

  The social and cultural aspects of a community include its traditions, social stratification, religious influences, and length of residence, or stability, among others. The term *socioeconomic status* is often used to describe characteristics of population groups related to income, residence, occupation and education. Poverty and low educational levels are often associated with the worst health problems worldwide. Activities that are detrimental to health, such as use of alcohol or tobacco among teenagers, may become social norms that are very difficult to change.

- **Lifestyle choices** are decisions made and actions taken by individuals that affect their health. These choices can include behaviors that cause risks to health, such as smoking or failing to use safety belts. Some lifestyle risks result from socioeconomic conditions, such as living in fear of violence in inner-city housing projects.

But many lifestyle risks are the result of conscious decisions people make that can be changed by choice. The top five leading causes of death in the United States are all related to lifestyle.

Number one is cardiovascular disease, related to the heart and blood vessels. Cardiovascular disease causes 46% of all deaths in the United States. Number two is cancer. About 1.1 million new cases are diagnosed each year. Cerebrovascular disease and chronic lung disease are also dramatically influenced by lifestyle choices, and unintentional injury can often be directly linked to individuals' choices.

- **Health care organization** includes the array of community health services available. Medical and dental services, hospitals, pharmacies and mental health services are a few examples of the health care offered in communities. There also may be nonmainstream sources of care, such as homeopathic practitioners, available in a community.

Approaches to Community Health

Three perspectives on health that go beyond the individual are used in community health:

- an ecological perspective, which views the individual in the context of the environment
- a demographic perspective, which views the individual in the context of broad population trends
- an epidemiological perspective, which considers the causes, frequencies and distribution of diseases in a population

- **Ecology** is the study of the relationships between and among living things and their environment. Human ecology is the study of the relationship between human beings and their environment. Often, human communities change the environment to their advantage, but sometimes these changes are detrimental.

  Human ecology studies various facets of the human environment, including physical/chemical (such as climate and soil); biological (nutrition, pathogens); and social/behavioral (social structure, stress). All of these aspects of the environment can influence the health of communities.

- **Demography** is the study of population changes over time. Demographers study birth and death rates and make projections about population growth. These population processes are related to government policies and to limits of food and fuel production.

Population Growth Can Be Hazardous to Health

- If current rates of population growth are maintained, the world's population will double in forty years.
- Two-thirds of the world's people do not have enough food to eat.
- Starvation and disease go hand in hand. Malnourished people are more susceptible to disease. People migrating due to famines often spread infectious disease.

- **Epidemiology** is the study of the distribution of diseases by person, place and time in a population and the factors that affect that distribution. Epidemiological methods allow community health workers to collect and analyze statistics on a community's health problems. Epidemiology looks at patterns of disease occurrence and compares people who have a particular problem with people who do not. Public health agencies use epidemiology data to determine what needs to be done to prevent the occurrence of disease.

Measuring Community Health and Disease

Epidemiologists make comparisons. Two basic measures used are *incidence* and *prevalence*. Incidence is the number of new cases of (or deaths from) a disease that occur during a given time period, such as a month or year. Prevalence is the number of cases that exist at a particular point in time.

Incidence is especially helpful in studying diseases that spread quickly, such as outbreaks of communicable diseases. Prevalence is widely used in measuring chronic or longer-term illnesses or conditions.

To compare incidence or prevalence of disease among population groups, rates are used. Just comparing the actual number of cases in different populations doesn't tell what *proportion* of the population is affected. The number could sound high but in reality could be only a very small part of the population if the total population is large.

Rates standardize the information, so fair comparisons can be made. For example, prevalence rates of AIDS can be described as the number of cases per 100,000 population (people). Diseases that are more common than AIDS could be described using a smaller number, such as cases per 1,000 population.

Host/Agent/Environment

Epidemiological concepts important to community health include the interaction of the disease's host (in this case, the person in whom the disease resides), the agent (that which carries the disease to the person) and the environment. Although these concepts were developed with communicable diseases in mind, they are now being used in the promotion of healthy lifestyles. For example: the *host* might be a high-risk individual (a smoker), the *agent* is tobacco, and the *environment* might be the mass media or the person's social milieu. This model can be used to design health promotion activities.

The Concept of Risk

Another epidemiological concept important in community health is *risk*. Relative risk describes the ratio of deaths or cases of a disease in those with a particular characteristic (such as smokers) to those deaths or cases among those without the characteristic. A risk factor is a characteristic or behavior pattern known to increase a person's relative risk; for example, smoking is a risk factor for heart disease.

Communicable Disease Control

Since the beginning of the twentieth century, there has been a dramatic decline in the number of deaths in the United States caused by communicable disease. Smallpox was the first communicable disease to be eradicated. Diseases such as diphtheria, polio, trichinosis and typhoid fever now seem almost extinct, and measles has been targeted for eradication. But if further reductions in these diseases are to be made, existing control measures cannot be taken for granted or relaxed. Maintaining high levels of immunization requires vigilance by community health agencies, schools and others.

Epidemiological Principles of Disease Control

In investigating an epidemic to determine its cause, the disease is categorized by time, place and person. By studying the time or place of onset in an epidemic, a shared event may be identified. The place of an epidemic can help to identify the cause, for example, when there are many cases in an area with a common water supply or when the people stricken have all eaten at the same place. The personal characteristics of those involved may point to the cause, for example, the sick people might share a common exposure to asbestos fibers in construction work.

Different modes of transmission of the communicable diseases result in the need for different strategies for control. For respiratory diseases, control has focused on strengthening the host's resistance through immunization, nutrition and general health promotion.

Diseases such as dysentery and typhoid fever, transmitted mainly by contaminated water and food, are controlled with environmental measures. These measures include water purification, sewage disposal and treatment, food protection and personal hygiene. General improvements in housing and better public understanding of disease control have also helped.

Some diseases are controlled through the killing or containment of *vectors*, animals that transfer disease from one host to another. Examples are rodents, mosquitoes, flies, ticks and fleas.

The diseases that are most difficult to control are those transmitted by direct contact, such as sexually transmitted diseases. For these diseases, public health education has been the most effective intervention.

Community Health Education

Health education in the community is planned by using theories and methods from a number of disciplines: the social and behavioral sciences, epidemiology, ecology and others. Health education principles include the following:

- Learning is cumulative and requires a sequence of experiences over time.
- The multiple causes of health problems must be addressed.
- Educational strategies must be adaptable for diverse subgroups of people in a population.
- The early involvement of consumers and care providers is needed for success.
- Methods of education should be chosen based upon the specific situation and audience.
- Health promotion through voluntary behavior change should be the goal, with a focus on economic accessibility and cultural compatibility.

Health education is evaluated both continuously (formative and process evaluation) and by measuring expected changes and results (impact and outcome evaluation).

Needs of Special Populations

Addressing the health needs of specific groups of people promotes the general well-being of the entire population. Many health problems are common to people at different stages of the life span.

- **Maternal, infant and child health:** This area includes community preventive care for the mother before and after delivery, care of infants and children, and education of the public about preventive health care. Preventive health care involves measures such as immunizations, dental care and family planning.

National objectives for maternal, infant and child health, and for the health of other special populations, are set by the U.S. Department of Health and Human Services. The intent of the objectives is to challenge both the public and the private sectors at national, state and local levels to work toward ending disparities in health based on income levels, location of residence and ethnicity.

On an international level, effective techniques for improving the chances for child survival in developing countries include:

- growth monitoring, combined with community health education
- oral rehydration therapy to combat dehydration, the single largest killer of young children
- breast-feeding
- immunization
- education, food supplements and family planning

A HISTORICAL PERSPECTIVE

At the turn of the century in the United States, more than 20,000 women died in childbirth each year. Now this number has been reduced to fewer than four hundred.

- **Adolescent and adult health:** No risk factor correlates more consistently with illness and death statistics than age. Therefore, age ranges are often used for planning health care programs. Adolescent health issues include sex and pregnancy, sexually transmitted disease and HIV/AIDS, smoking and drug use, and intentional and unintentional injury.

Principal causes of death for adults are cardiovascular disease, cancer, unintentional injury, stroke and chronic liver diseases. For both adolescents and adults, promotion of a healthy lifestyle is basic to prevention of these problems.

- **Older adults:** A community approach to the health of older adults must avoid stereotypes and discrimination based on age. Many of the health problems associated with aging, such as diseases of the heart and other degenerative diseases, require far more medical care than those of younger people.

  Health priorities for older adults include preventing infectious diseases such as influenza and pneumonia, injury control and nutrition. Early detection and treatment of cancer and high blood pressure are also important. Other common problems include arthritis and rheumatism, vision disorders and loss of hearing.

  Loss of vision and hearing can lead to a sense of social isolation. In fact, when asked to rank the importance of 15 priorities for health promotion and disease prevention in the health objectives for the nation, the elderly gave highest priority to sensory deprivation control, a category that was not even on the list of priorities for the population as a whole.

  A community health program for the elderly should take into account medical services, hospital facilities, nursing home services, housing conditions, health education and counseling, recreation programs, and provisions for participation in productive and enjoyable activities. At clear transition points, such as retirement, relocation and widowhood, professionals can help people anticipate needed lifestyle adjustments that can promote health.

Community Mental Health

Mental health refers to an individual's emotional and social well-being, including psychological resources. While most communities have provisions for treating the mentally ill, very few have a well-functioning program for promoting the mental health of all residents.

Although most people have a vital interest in the mental health of their community, neighborhood and family, few want to have a mental health facility located in their neighborhood. This sentiment reflects the fear and stigma still associated with mental illness.

A community's mental health needs may be very specific. The needs may be related to a community's economic status, ethnic composition, community norms and other factors.

TECHNOSTRESS

A new syndrome called technostress has become a community mental health concern. Technostress refers to the sense of isolation and alienation of people from one another when work on computers replaces human contact. One way technostress appears is as obsession or overidentification with computer technology, leading to a loss of capacity to feel and relate to others.

Violence is now viewed as a public and community health issue, because of the related injuries and deaths and the underlying social problems that lead to violence. Violence includes gang behavior, child and spouse abuse, rape and assault, and other intentional injury.

Excessive and continuous stress is a risk factor for many health problems and a contributing cause to violent behavior. It is generally agreed that homicide and suicide result from increased levels of stress. In particular, those living in poverty and certain age groups seem to be more vulnerable to violent outcomes of stress.

1-Minute Facts

- Promoting the health of communities involves educational, social and environmental actions that enhance health.
- The health of a community is affected by four factors: human biology, environment, lifestyle choices and health care organization.
- Community health uses three perspectives: ecological, demographic and epidemiological.
- Community health measures have contributed to a dramatic decline in the number of deaths caused by communicable disease in the United States.
- Health education in the community uses theories and methods from a number of disciplines.
- Addressing health needs of specific groups of people promotes the general well-being of the entire population.
- Few communities have well-functioning programs for promoting the mental health of all residents.

Community Resources and Services

Myth: Local governments develop a community's health services.

Fact: The health care system in a particular community is set in a national and statewide context, which is influenced by geography, economics, culture and other social factors. Communities usually have public, voluntary and privately-owned health agencies.

Health-related resources and services located in communities are part of a larger national context. The United States has official government agencies that are responsible for health issues. Professional health organizations serve both the member health care professionals and the general public. Many philanthropic foundations support community health programs.

State governments function as intermediate level administrators of health programs, but the community is where most services actually are offered and used.

The National Context

A community's health services reflect not just local historical conditions, but also the history of the nation and the world that has shaped the community. National politics and economics help determine the resources available to communities.

In the United States, the federal government has no direct Constitutional authority to engage in public health activities, but authority to promote health is given as part of the government's responsibility for general welfare. The federal government has the power to appropriate money and create agencies to deal with specific health problems, among other specific powers.

The organization and priorities of the nation's health services administration undergo changes, often when a new president is elected. The following descriptions of structure, functions and priorities may change as new administrations enact reforms.

Federal Departments with Health Services

In the United States, many agencies in each executive department of the federal government are involved in health work. Examples include the following departments:

- Agriculture
- Commerce
- Defense
- Health and Human Services
- Interior
- Justice
- Labor

■ **Department of Agriculture (USDA):** This department contributes more community health service to the nation than any other except the Department of Health and Human Services. Its programs include:

- Women, Infants and Children (WIC) food assistance program
- agricultural and industrial programs that study food and drugs of importance to health
- dairy industry sanitation
- promotion of rural health and environmental sanitation through the Extension Service

■ **Department of Commerce:** The Bureau of the Census, which collects statistics on the population, is located here. Also located in this department is the Maritime Administration, which covers medical and dental services for merchant marines.

■ **Department of Defense:** This department provides health and medical care for members of the armed services and their dependents. Health promotion has been heavily emphasized as concerns about fitness and substance use have grown.

■ **Department of Health and Human Services:** The Public Health Service is located here, along with health care finance, social security and human development offices.

The Agencies of the Public Health Service

- Centers for Disease Control and Prevention (CDC)
- National Institutes of Health
- Health Resources and Services Administration
- Food and Drug Administration (FDA)
- Indian Health Service
- Alcohol, Drug Abuse and Mental Health Administration

- **Department of the Interior:** This department consists of the Bureau of Mines, the Fish and Wildlife Service and the National Park Service. These offices conduct essential environmental health services.

- **Department of Justice:** Prisons and immigration and naturalization are the responsibilities of this department, which works with the Public Health Service on health issues for these populations.

- **Department of Labor:** The health of workers is this department's responsibility.

Independent Federal Agencies

The most important independent agency with health responsibilities within the federal government is the Environmental Protection Agency (EPA). The EPA is responsible for air and water quality standards. It has the following duties:

- funds construction of wastewater treatment plants
- funds the cleanup of hazardous waste sites (Superfund)
- regulates hazardous waste disposal
- funds water quality programs
- is responsible for radiation control

The EPA also provides grants for research on environmental pollutants and risk assessment methods.

Among the numerous other independent federal agencies are the National Science Foundation, which supports basic scientific and health research, and the Consumer Product Safety Commission, which sets standards and reviews complaints about product safety.

Spotlight on the CDC

The Centers for Disease Control and Prevention (CDC) is well known for its efforts to fight communicable disease. It tracks disease incidence and trends across the country and worldwide, so health authorities can take quick action in response to outbreaks, epidemics and natural disasters.

Each year, CDC helps state health departments investigate more than 1,500 outbreaks of disease. One well-known example was the 1976 investigation of Legionnaire's disease in Philadelphia.

CDC helps state and local health departments set up disease control programs, including programs for sexually transmitted disease control, immunization and community water fluoridation. The CDC laboratory also offers diagnostic services for unusual problems.

In recent years, CDC has been active in assessing health problems relating to environmental and occupational exposures to toxic substances and other pollutants. CDC has studied the health consequences of the Three Mile Island nuclear incident, the health effects of the volcanic eruption of Mount St. Helens and the potential risks of heat waves.

Professional Health Organizations

Professional associations are formed by people with a common purpose to uphold certain professional standards and to provide better service through united efforts. The associations also promote the interests of the profession and its members; however, an association's image depends on its service to the public.

A number of organizations target the health and well-being of school-age children and youth. Some of the larger organizations that are concerned with the health of all populations include:

- American Medical Association
- American Dental Association
- American Public Health Association
- American Nurses' Association

- **The American Medical Association** (AMA) is a group of state and county medical societies. The AMA informs members of advancements in medicine and related fields and helps with hospital accreditation. The AMA publishes the *Journal of the American Medical Association*, a weekly publication regarded as a leading journal in its field.

- **The American Dental Association** is an association of state and county dental societies. Like the AMA, this association informs practitioners of new developments in the field. It publishes the *Journal of the American Dental Association*.

- **The American Public Health Association** is an organization with broad public health interests. This association has developed standards and procedures that have been widely adopted, including methods for inspecting water and sewage, guidelines for operating swimming pools and public health training standards. It publishes the *American Journal of Public Health* on a monthly basis.

- **The American Nurses' Association** represents registered nurses in setting standards of practice, education and nursing services. *The American Journal of Nursing* is published monthly. The association is involved in credentialing and licensing of nurses as well as accreditation for nursing schools and services.

Health Foundations

A number of philanthropic foundations receive money from wealthy individuals or corporations. Many of these foundations have made a very strong commitment to funding projects designed to prevent disease or improve health in special populations. Usually, the name of the foundation bears the name of the donating person or corporation. Some large foundations with a strong association with community health programs carry the following names: Kaiser Family, Robert Wood John-

son, Robert W. Woodruff, Kellogg, and Milbank. Most public libraries have books with detailed lists of foundations and what they are interested in funding.

State Agencies

Each state has both official and voluntary health agencies. Official health agencies are government agencies supported by tax funds. Voluntary agencies are supported by financial contributions from individuals and organizations. While voluntary agencies have national offices, they operate most effectively at the state level to plan programs and raise funds.

State Government

Most states grant the legislature the authority to establish the necessary health agencies. In some states, such as California, impatience with the legislative process has led to many health initiatives by referendum on the state ballot. Initiatives have included an increase in cigarette taxes to pay for health education and smoking prevention programs.

In most states, a board of health takes responsibility for health regulations, standards and requirements. Usually, a board has about nine members who are appointed by the governor.

The structure of state health departments varies; however, the functions are similar. State health departments are responsible for some or all of the following services, among others:

- emergency medical services
- maternal and child health
- disabled children's programs
- chronic disease services
- public health nursing
- communicable disease services
- epidemiology
- laboratory services

- veterinary public health
- hospital licensure and certification
- health maintenance organizations
- vital statistics
- long-term care
- state health planning
- consumer health protection
- environmental health
- public health education

Voluntary Health Agencies

Voluntary health agencies are formed to deal with certain problems relating to disease prevention and control. Many agencies focus on specific types of diseases (e.g., lung disease, heart disease, cancer). They frequently address problems that could be avoided through early preventive education.

Voluntary health agencies depend on donations of time and money from individuals in the community in order to function. While there may be a few paid staff members, most of the organization's work is carried out by volunteers.

Some major voluntary health organizations are the American Red Cross, the American Cancer Society, the American Lung Association and the American Heart Association. These agencies are extensively organized, with a nationwide network of local chapters and volunteers.

Usually, these agencies are also experienced at collaboration. For example, ten years ago, the American Heart Association, the American Lung Association and the American Cancer Society joined together to form the Coalition on Smoking and Health in order to influence public policy on tobacco. Together they were able to have a much greater effect on public policy toward tobacco than they would have had on their own.

Much of the work of voluntary health agencies is educational. Many agencies have developed printed and other educational materials as well as expertise in working with the media and policy-makers. Some have also developed curriculum materials for students and inservice programs for teachers.

Community-Based Resources and Services

State legislatures delegate authority to counties. The county board of supervisors or board of commissioners appoints a county board of health. Counties and sometimes cities (if they are large) have their own health departments, generally referred to as *local health departments.*

Local Health Departments

The county board of health appoints a *health officer* who serves as director of the local health department. The health officer is usually a physician with training in public health.

County health programs are carried out by a professional staff. While there is no absolute standard for the size of the staff, general guidelines exist. For economic feasibility, a population of 50,000 is considered the minimum size requiring a health department. Smaller counties sometimes contract with the state for services or join with other small counties to form a district health unit.

Although services vary in different local health departments, some basic services that are typically found include:

- vital statistics
- communicable disease control
- maternal and child health
- chronic disease control
- mental health services
- environmental health protection
- laboratory service
- health education

Health Care Facilities

Most communities have a number of different types of health care facilities, including hospitals, clinics, nursing homes and rehabilitation centers. A recent development in many communities is the addition of private drop-in emergency medical centers.

Hospitals may be private, public or voluntary. *Private*, or *proprietary*, hospitals are profit-making institutions. They usually accept only patients who can pay all of their expenses. Often these are relatively small hospitals with limited services. They may be owned by a group of business investors, a large hospital corporation or a group of physicians.

Public hospitals are publicly funded, supported mainly by taxes. They are run by federal, state, county or city government agencies. State mental hospitals and federal Veterans' Administration hospitals are public hospitals. Large county or city hospitals generally serve low-income populations and may serve as teaching hospitals for local medical schools.

Voluntary hospitals are the most common type of hospital. They are nonprofit institutions that usually offer a wider range of services than private or public hospitals. These hospitals may also have specialized programs such as stress centers, chemical dependence programs or health education centers. Voluntary hospitals are supported by patient fees along with contributions from the community.

Nursing homes and home care agencies often are private enterprises. Some nursing homes now have special patient care programs, such as for Alzheimer's disease. County departments of health and social services also offer health-related care for some low-income groups.

Private surgery centers and drop-in clinics have their own staff of health care professionals. Some specialize in meeting the needs of certain segments of the population, such as women or older members of the community.

Many nonprofit agencies and organizations also offer health care services to specific populations, for example, minority groups or battered women. Planned Parenthood is a nonprofit organization that provides educational as well as low-cost health care services for women. Local nonprofit clinics often have limited budgets and must raise funds from community and other sources.

Community/School Partnerships

As recommended in the U.S. Public Health Service plan for improving the health of Americans by the year 2000, *Healthy People 2000: National Health Promotion and Disease Prevention Objectives*, schools should have a special role in enhancing and maintaining the health of their communities' children. The plan advocates a partnership among parents, schools and other community groups to create health promotion programs and to enhance health education curricula.

Through a comprehensive school health program, schools can promote the health of students by establishing goals and developing a planned implementation process. This process should build on the aspirations and commitment of parents, school leaders and communities to ensure that all children achieve optimal health and reach their full potential.

Integrated Services

Other programs for children and families also require a coordinated effort in the community. Often, services designed to help families with health problems are offered in a fragmented way and are not coordinated with one another. One organizational change now being explored is a new type of collaborative effort in planning and delivering services, with a focus on prevention.

These partnerships can offer local agencies the chance to pool resources to handle issues that may be beyond the scope of any one agency. Often these programs are located in accessible neighborhood locations such as schools or clinics and are intended to address diverse cultural needs.

Tips for Success

It can be a major challenge for agencies and schools to create necessary partnerships. Differences in professional training and vocabulary, competition for funding, confidentiality issues and other difficulties can work against the integration of services.

Some of the ways a community can successfully work toward this goal include:

- Create a "children's report card" to raise awareness about important health issues, highlight successes and assess local needs.
- Learn about each other's programs, service criteria and funding streams.
- Define what "partnership" means in specific terms.
- View recipients as customers, not clients.
- Involve families in planning or evaluating services.
- Include formal and informal community leaders early on.
- Create a community vision with consistency and focus.
- Reflect local population diversity through culturally and linguistically appropriate services.
- Allow enough time for planning and development.
- Identify barriers to collaboration and develop strategies for overcoming them.
- Market the program and celebrate successes along the way.

Policy and Financing Issues

In the United States, rising health care costs have caused major concern in both public and private sectors. Medicare funds care for older Americans, and Medicaid funds care for low-income Americans. Each year between 1967 and 1991, Medicare costs rose 10%, and Medicaid costs rose 16%. Left unchanged, these two programs alone would consume 24% of all federal spending by the year 2002.

Private businesses are also hit hard by rising health care costs. Most Americans pay health care costs through insurance plans at their workplace. As an example, Ford Motor Company's health care costs were 6% of payroll costs in 1970

and almost 20% in 1991. At the 1992 economic conference held by the president of the United States to discuss the issue, Ford's chairman and CEO said, "Ford spends as much on health care as it does on steel."

In 1993, at least 37 million Americans had no health insurance, and 1 million people were losing their coverage each year. Beginning with the recession of 1981/82, corporate employers began cutting health benefits and requiring employees to pay more for them.

A Comparison of Health Care Statistics

	U.S.	Canada	Japan
Health spending per capita	$2,867	$1,915	$1,267
Spending as % of GNP*	13.4%	10.0%	6.6%
Life expectancy at birth			
Women	78.8 yrs	80.4 yrs	81.9 yrs
Men	72.0 yrs	73.8 yrs	75.9 yrs
Doctor visits per year	5.5	6.9	N/A
Average hospital stay	9.1 days	13.9 days	50.5 days
Average doctor earnings	$155,800	$84,921	$45,160
Percent of population covered by public health plan	44%	100%	100%

*Gross National Product

Source: Organization for Economic Cooperation and Development [reported in *San Jose Mercury News*, September 19, 1993].

Cost Containment

Many countries have lower per capita costs for health care than the United States and rank better in terms of life expectancy and other measures. Most of these countries have a national health care program (either paying for health care or providing services). More than fifty nations have national medical service programs, and virtually all are "socialized," or administered by the government.

In the United States, many proposals for restructuring the health care system to contain costs and improve accessibility to services have been made in both public and private sectors. In 1993, President Clinton proposed a new health care plan that would guarantee a basic health benefits plan to all Americans. Under the plan, most Americans would be assigned to a regional health alliance, which would negotiate medical coverage for its members.

One way that costs have been contained in the United States is through the use of health maintenance organizations (HMOs). HMOs are organized systems set up to provide comprehensive health maintenance and treatment services. They are available to a group of people in a geographical area who voluntarily enroll in them. People who enroll prepay for services on a regular basis, usually monthly. Use of HMOs would probably increase under Clinton's proposed health care plan.

One example of a generally successful HMO is the plan run by the Kaiser-Permanente Foundation. The idea behind the system was to use resources efficiently to route patients to appropriate "centers," with health education built into the treatment plan. Administration and use of facilities would be shared by the centers for efficiency and cost savings. While Kaiser-Permanente was a pioneer in "managed care," even this plan had to make steep increases in monthly premiums during the eighties and nineties to cover the rising costs of health care.

Health care reforms could cause major changes in how state and local health care organizations operate. Reforms may be difficult to enact and put into practice, but most Americans agree that some action must be taken to stem rising health care costs.

1-Minute Facts

- Health-related resources and services in communities are part of a larger national context.
- National politics and economics help determine the resources available to communities.
- States have both official and voluntary health agencies.
- Counties and some cities have their own health departments.
- *Healthy People 2000* advocates a partnership among parents, schools and other community groups to create health promotion programs and to enhance health education curricula.
- In the United States, rising health care costs have caused major concern in both public and private sectors.

Glossary

A

acid rain—Pollutant that forms when moisture in the air combines with nitrogen oxide and sulfur dioxide released by factories, power plants and motor vehicles that burn coal or oil.

atmosphere—The mass of air surrounding the earth.

B

bioaccumulate—Process by which substances that are not broken down by decomposer organisms accumulate in increasing amounts along the food chain.

biodegradable—Materials that decompose readily in the proper disposal environment.

biodiversity—Biological diversity in ecological systems, represented by the variations in both the physical (e.g., soil, water) and species composition of the systems and the interactions between them.

biological controls—The use of predators or pathogens to control pests.

C

carbon cycle—Process by which carbon is cycled through the environment by fixation of carbon dioxide followed by its release with decomposition of plants and respiration in animals.

chloroform—A poisonous liquid that forms when chlorine is added to drinking water.

chlorofluorocarbon (CFC)—Chemical used as cooling agent in refrigerators and air conditioners, as blowing agent for foam insulation and as cleaning agent.

community health—Local public and private sectors working together to enhance the health of people living in a specific area through educational, social and environmental efforts.

composting—A method of recycling food and yard waste into useful, nutrient-rich mulch for gardens and landscaping through a process using different combinations of organic materials and sunlight to break down the materials.

D

demography—The study of population changes over time, which can be used to project population growth and thus influence government policies.

E

ecology—The study of the relationships among living things, and between living things and their environment.

ecosystem—The complex web or biological community in an area linking animals, plants, air, water and all other life forms on earth.

effluent—The outflow of a sewer, septic tank or sewage treatment plant.

environment—The complex of climate, soil and biotic factors that act upon an organism or an ecological community and ultimately determine its form and survival.

epidemiology—The study of the distribution of diseases by person, place and time in a population and the factors that influence the occurrence of disease.

eutrophication—Nutrient enrichment of a lake or stream, often by runoff of fertilizer or addition of sewage, which frequently causes rapid growth of algae, which depletes oxygen, resulting in suffocation of fish and other animals.

F

fossil fuels—Materials burned to produce heat or power that are derived from living things preserved in the earth's crust (e.g., coal, oil, natural gas).

G

greenhouse effect/global warming—The warming of the earth's surface that occurs when certain gases allow sunlight to reach the ground but prevent the sunlight's heat from rising out of the atmosphere and flowing back into space.

H

health maintenance organization (HMO)—Organized system set up to provide comprehensive health maintenance and treatment services as a way to keep costs contained; available to a group of people in a geographical area who voluntarily enroll and prepay for services on a regular basis.

health officer—Director of the local health department, usually a physician with public health training, appointed by the county board of health.

hydrologic cycle—Process involving evaporation and precipitation of water. See water cycle.

I

incidence—One of the basic measures in epidemiology; the number of new cases (or deaths) of a disease that occur during a given time period.

incineration—Burning waste in specially designed furnaces where materials are burned at very high temperatures, converting them to gases and leaving small amounts of residue that can be disposed of in landfills.

L

local health department—Usually a county health program carried out by professional staff serving a population of at least 50,000.

N

nitrogen cycle—Process by which nitrogen is recycled in the environment, used by living things and passed to the environment, where it is carried by soil, air, and water and later returned to living systems.

nitrogen fixation—Part of the nitrogen cycle when bacteria and blue-green algae convert nitrogen into fixed nitrogen, which is usable as organic compounds.

nutrient—One of the chemical building blocks of life (e.g., water, carbon, hydrogen, oxygen, nitrogen).

nutrient cycles—Natural environmental cycles describing the pathways that nutrients take as they move from living to nonliving parts of the environment and back again.

O

ocean dumping—A method of solid waste disposal in which waste is taken to offshore dump sites, contributing to water pollution and changes in the habitat of many marine plants and fish.

official health agencies—Government agencies supported by tax funds.

open dumping—A method of solid waste disposal that involves compaction and dumping at a dump site.

organic farming—Agricultural methods that do not use human-made (synthetic) pesticides, herbicides, fungicides or fertilizers. (See also sustainable agriculture.)

ozone—A vital component of the upper atmosphere, but at ground level a dangerous pollutant. It is generated at ground-level by motor vehicles, power plants and oil refineries.

ozone layer—A band of ozone in the atmosphere, six to thirty miles above the earth's surface, which forms a shield that protects the earth from the sun's ultraviolet radiation.

P

particulates—Tiny particles found in air pollution that can harm health and damage the environment.

photosynthesis—The process by which green plants take up carbon dioxide and convert it to carbohydrates and oxygen.

pollutants—Waste products that cause pollution (e.g., gas, smoke, chemicals).

pollution—Contamination of the environment, especially with human-made waste.

prevalence—One of the basic measures in epidemiology; the number of cases that exist at a particular point in time.

private hospital—A hospital that is a profit-making institution; also called a proprietary hospital.

proprietary hospital—A hospital that is a profit-making institution; also called a private hospital.

public hospital—A publicly-funded hospital supported mainly by taxes and run by federal, state, county or city government agencies.

R

radiation—An invisible pollutant that can be extremely dangerous. It usually refers to ionizing radiation, which produces electrically-charged particles called ions in the molecules it strikes (e.g., X-rays, radioactivity and cosmic rays).

recycling—A method of reducing solid waste that involves converting disposable items into reusable materials.

renewable resource—A resource that is replenished as opposed to being used up over time.

risk—An epidemiological concept important in community health; may be a relative measure between two different characteristics or behaviors and their relation to a particular disease (e.g., inhaling cigarette smoke increases a person's risk of getting lung cancer).

S

sanitary landfill—Specially planned and supervised disposal site where waste is disposed of in pits and covered with a layer of soil daily.

smog—A commonly recognized type of air pollution that involves a condition caused by the action of sunlight on the exhaust gases from motor vehicles and factories.

sustainable agriculture—Agricultural practices that consider long-term economic, ecological and social viability.

T

thermal inversion—A weather condition in which a layer of heavy, cool air becomes trapped beneath a layer of still, warm air. Also called temperature inversion.

thermal pollution—Heat pollution from the use or production of energy resources (e.g., automobiles or hydroelectric dams).

V

voluntary health agency—An agency that depends on donations of time and money from community members to function.

voluntary hospital—The most common type of hospital, a hospital that functions as a nonprofit institution and offers a wider range of services than private or public hospitals; supported by patient fees and community contributions.

W

water cycle—Process driven by solar energy, which evaporates water, and by gravity, which draws water back to earth as precipitation.

Resources

American Association of Zoological Parks and Aquariums
7970 Old Georgetown Rd.
Bethesda, MD 20814
301-907-7777

American Forest
1516 P St. NW
Washington, DC 20005
202-667-3300

CEDAM International
One Fox Rd.
Croton-on-Hudson, NY 10520
914-271-5365

Center for Marine Conservation
1725 DeSales St. NW
Washington, DC 20036
202-429-5609

Children's Alliance for Protection of the Environment
1301 W. Fifth St.
Austin, TX 78703
512-476-2273

Cousteau Society
870 Greenbrier Circle
Chesapeake, VA 23320
804-523-9335

Department of Energy
Office of Fossil Energy
1000 Independence Ave. SW
Washington, DC 20585
202-586-6660

Department of the Interior
U.S. Fish and Wildlife Service
Publications Office
130 WEBB
4401 N. Fairfax Dr.
Arlington, VA 22203
703-358-1711

EarthSave Foundation
706 Frederick St.
Santa Cruz, CA 95062
408-423-4069
408-459-9344—YES Tour
(peer education)

The Environmental Defense Fund
257 Park Ave. South
New York, NY
212-505-2100

Environmental Education Associates
2000 P St. NW, Suite 515
Washington, DC 20036
202-296-4572

Environmental Law Institute
1616 P St. NW, 2nd Floor
Washington, DC 20036
202-328-5150

Environmental Protection Agency
Public Information Center
401 M St. SW
Washington, DC 20460
202-260-7751

ERIC Clearinghouse for Science, Mathematics and Environmental Education
1929 Kenny Rd.
Columbus, OH 43210
614-292-6717

Forest Service
Department of Agriculture
201 14th St. SW
Washington, DC 20250
202-205-1760

Global Response
1133 Pearl St.
Boulder, CO 80302
303-444-0306

Greens/Green Party USA Clearinghouse
P.O. Box 30208
Kansas City, MO 64112
816-931-9366
Hotline: 800-257-7336

Greenpeace
1436 U St. NW
Washington, DC 20009
202-462-1177

International Society of Tropical Foresters
5400 Grosvenor Lane
Bethesda, MD 20814
301-897-8720, ext. 127

National Audubon Society
700 Broadway
New York, NY 10003
212-979-3000

National Eldercare Institute on Health Promotion
601 E St. NW, 5th Floor
Washington, DC 20049
202-434-2200

National Environmental Education and Training Foundation
915 15th St. NW, Suite 200
Washington, DC 20005
202-628-8200

National Geographic Society
17th and M St.
Washington, DC 20036
202-857-7000

National Oceanic and Atmospheric Administration
Public Affairs Office
11400 Rockville Pike
Rockville, MD 20852
301-443-8243

National Pesticide Telecommunications Network
TTU-HSC
Thompson Hall, Room S129
Lubbock, TX 79430
806-743-3095
Hotline: 800-858-7378

National Solid Waste Management
1730 Rhode Island Ave. NW
Washington, DC 20036
202-659-4613

National Wildlife Federation
1412 16th St. NW
Washington, DC 20036
202-797-6800

Natural Resources Defense Council
40 W. 20th St.
New York, NY 10011
212-727-2700

The Nature Conservancy
1815 Lynn St.
Arlington, VA 22209
703-841-5300

North American Association for Environmental Education
1255 23rd St. NW
Washington, DC 20037
202-467-8754

Ontario Ministry of Energy
Energy Inquiry
56 Wellesley St. West, 9th Floor
Toronto, Ontario M7A 2B7
Canada
416-323-4231

Rainforest Action Network
450 Sansome St., Suite 700
San Francisco, CA 94111
415-398-4404

Rainforest Alliance
65 Blucker St.
New York, NY 10012
212-677-1900

Renew America
1410 16th St. NW, Suite 710
Washington, DC 20036
202-232-2252
Hotline: 800-922-RENEW

Rodale Institute Research Center
33 E. Minor St.
Emmaus, PA 18098
215-683-6383

Safe Drinking Water Hotline
USEPA
401 M St., Suite G099
Washington, DC 20460
Hotline: 800-426-4791

Sierra Club
730 Polk St.
San Francisco, CA 94109
415-776-2211

Society of American Foresters
5400 Grosvenor Lane
Bethesda, MD 20814
301-897-8720

Tree People
12601 Mulholland Dr.
Beverly Hills, CA 90210
818-753-4600

Trees for Life
1103 N. Jefferson
Wichita, KS 67203
316-263-7294

Toxic Substances Control Act
Assistance Information Service
401 M St. SW
Washington, DC 20024
202-554-0515
Hotline: 800-554-1404

Toxicology Information Response
Center
Oak Ridge National Laboratory
Bldg. 2001, P.O. Box 2008
Oak Ridge, TN 37831
615-576-1746

Union of Concerned Scientists
26 Church St.
Cambridge, MA 02238
617-547-5552

The Video Project
5332 College Ave., Suite 101
Oakland, CA 94618
800-4-PLANET

The Wilderness Society
900 17th St. NW
Washington, DC 20006
202-833-2300

Worldwatch Institute
1776 Massachusetts Ave.
Washington, DC 20036
202-452-1999

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